



New species of *Chaetozone* and *Tharyx* (Polychaeta: Cirratulidae) from the Alaskan and Canadian Arctic and the Northeastern Pacific, including a description of the lectotype of *Chaetozone setosa* Malmgren from Spitsbergen in the Norwegian Arctic

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Abstract

Eight new species of cirratulid polychaetes of the genus *Chaetozone* from the Alaskan (Beaufort Sea) and Canadian Arctic (Baffin Island, Baffin Bay, Labrador, Hudson Strait, and Hudson Bay) and the Northeastern Pacific are reported together with two new species of *Tharyx* from the Alaskan Beaufort Sea and the Strait of Juan de Fuca. The new species of *Chaetozone* and *Tharyx* are compared with related species; distinct species groups within these genera are discussed. A redescription of *C. setosa* Malmgren, 1867, the type species of the genus from Spitsbergen, based on a lectotype and associated paralectotypes designated by the late Dr. Mary E. Petersen is presented. A review of characters important in the taxonomy of the genera *Chaetozone* and *Tharyx* is presented. A key to species of *Chaetozone* from the Northeastern Pacific and North American Arctic is provided.

Key words: Annelida, Arctic, benthos, Puget Sound, British Columbia, Alaska, Canada, new species

Introduction

As part of continuing research on global collections of Cirratulidae, materials from the North American Arctic, subarctic, and northwest coast of North America have been examined, resulting in the recognition of eight new species of *Chaetozone* and two new species of *Tharyx*. Most records of the new *Chaetozone* species were previously referred to the type species, *C. setosa* Malmgren, 1867, in technical reports and published papers. For example, in a review of Arctic polychaetes, Jirkov (2001) listed only *C. setosa* as present from among bitentaculate genera. As reported by Blake (1996, 2006), detailed morphological investigations of bitentaculate cirratulids suggest that numerous local, endemic species with defined habitat preferences, depth ranges, and geographic distributions are present among materials previously assigned to a single species. Most of the new species reported here have relatively narrow depth ranges and distributions based on available materials. The new species of *Chaetozone* and *Tharyx* greatly increase the number of known species of Cirratulidae from Arctic, subarctic, and boreal seas.

The earliest confirmed records of the genus *Chaetozone* from the North American Arctic and sub-Arctic were by Pettibone (1954) from Point Barrow, Alaska; Pettibone (1956) from offshore Labrador; and Blake & Dean (1973) from off Baffin Island. Each of these authors referred their specimens to the type species, *C. setosa*. As will be seen in this paper, all of these records and others refer to different species. There are no prior records of the genus *Tharyx* in the North American Arctic, although some specimens identified as *C. setosa* by Pettibone (1954) actually belong to a new species of *Tharyx*.

In contrast to the Arctic and subarctic, cirratulids of the genus *Chaetozone* from the Northeastern Pacific are relatively well known following the works of Hartman (1961, 1969), Banse & Hobson (1968), and Blake (1996, 2006). From these studies, a total of 16 species of *Chaetozone* are currently known from California to British Columbia (Blake 1996, 2006). Additionally, two species of *Tharyx* were reported by Blake (1996) from the same geographic area. Earlier records of *Tharyx* in California and elsewhere in the Northeastern Pacific had been referred previously to the genus *Aphelochaeta* (Blake 1991). The additional new species of *Chaetozone* and *Tharyx* from Oregon to Southeastern Alaska reported in this paper together with the Arctic and subarctic species add 10 new species to the previous totals for these genera in North American waters.

In order to better separate the growing number of *Chaetozone* species from one another, a redescription of the lectotype of the type-species *C. setosa* from Spitsbergen is provided based on slide mounts, detailed notes, and preliminary illustrations prepared by the late Dr. Mary E. Petersen to whom this paper is dedicated.

Material and methods

All specimens were examined with traditional light microscopy using a Wild M-5 stereomicroscope and a Zeiss RA research compound microscope equipped with phase contrast and Nomarski differential interference optics. Photomicrographs were taken with a Nikon D80 camera mounted on both the stereo- and compound microscopes. Some specimens were initially stained with a solution of Shirlastain A in water to highlight difficult-to-see surficial morphology. Some specimens were further stained with a saturated solution of Methyl Green (MG) in ethyl alcohol in order to elucidate distinct patterns evident on some species. Both stains dissipate completely in ethyl alcohol. Line drawings were made with pencil using a drawing tube or Camera Lucida on the Zeiss RA and later transferred to drawing paper and inked.

Collections were provided in part by the United States National Museum of Natural History (USNM) and Los Angeles County Museum of Natural History (LACM-AHF Poly); additional NE Pacific and Alaskan materials collected as part of local monitoring and reconnaissance programs were provided by Mr. R. Eugene Ruff, Ruff Systematics, Puyallup, WA; some specimens from Deception Bay, Quebec, were provided by Ms. J  sica Goldsmit, University of Montreal, and deposited in the Canadian Museum of Nature, Ottawa, Canada (CMNA). Collections from Prince Rupert, BC, were part of an environmental survey performed by AECOM Technical Services and processed and analyzed at my former laboratory in Woods Hole, MA.

Abbreviations used on figures: br, branchiae; nuO, nuchal organ; per, peristomium; pr, prostomium; pyg, pygidium; seg, segment; set, setiger; tn, tentacle. Within the text, Methyl Green is abbreviated as an acronym (MG) throughout except in subheadings.

Taxonomic account

Remarks on the Lectotype and Paralectotypes of *Chaetozone setosa* Malmgren

Historically, bitentaculate specimens of *Chaetozone* having posterior spines arranged into cinctures on posterior segments were referred globally to *C. setosa* Malmgren, the type species originally described from Spitsbergen, an archipelago in the Arctic north of Norway. Elucidation of new characters among species of *Chaetozone* from North America and elsewhere has led to descriptions of numerous new species and identification of distinct species groups (Blake 1996, 2006; Doner & Blake 2006). With the realization that the genus *Chaetozone* contains numerous species, many of which have gone unrecognized, the greater majority of the older records of *C. setosa* from worldwide locations are now believed to refer to other taxa.

In order to address the problem of the identity of the original *C. setosa*, the late Dr. Mary E. Petersen acquired and examined the Malmgren syntype collection of several lots of *Chaetozone* that were deposited in the Swedish Museum of Natural History (SMNH). As part of this investigation, a lectotype (SMNH 1493-03) was selected from one of the sample lots (SMNH 1493) and so designated by Petersen (1999). In 1996–1997, Dr. Petersen and a student, Mr. Salvador García-Martín prepared a series of illustrations and descriptions of *Chaetozone setosa* with the aim of publishing a redescription of the type species based on the lectotype and paralectotype series together with several other species, new to science, among the Malmgren collections and others from the SMNH. I was aware of this work and Dr. Petersen provided me with data from her study of the Malmgren syntypes that was helpful in developing my own publications on the eastern Pacific species of *Chaetozone* (Blake 1996, 2006). This information was also made available to my student, Ms. Stacy Doner, as part of her on-going studies of bitentaculate cirratulids, which includes collections of *Chaetozone* from the U.S. Atlantic shelf and slope, Gulf of Mexico, Antarctica, the Norwegian Arctic and elsewhere. In a paper on deep-sea *Chaetozone* from offshore northern California, Blake (2006) referenced notes on the morphology of the lectotype (SMNH 1493-03) of *C. setosa* provided by Dr. Petersen in order to better compare these taxa with the type species; this same information has been critical in defining the eight new species of *Chaetozone* reported in the present paper. More recently, Dr. Petersen and I had discussed further collaboration intended to assess the numerous global records of *Chaetozone* species referred to *C. setosa*.

Subsequent to the initial studies by Dr. Petersen and Mr. García-Martín, Dr. Susan Chambers of the Royal Scottish Museum borrowed some of these same lots from the SMNH and prepared her own redescription of *C. setosa*. Dr. Chambers' resultant publication included the designation of a lectotype and seven paralectotypes from lot No. 1495 and three additional paralectotypes from lot No. 1494 (Chambers 2000). Since Dr. Petersen had already published the designation of a lectotype (see Petersen 1999, page 111), the specimens selected by Chambers become at best paralectotypes. Three paralectotypes designated by Chambers from lot 3464 are invalid as types because they were collected in 1868, after Malmgren's manuscript was submitted for publication on 05 April 1867.

With the recent death of Dr. Petersen and the larger planned collaboration on *C. setosa* records no longer possible, a brief description of the lectotype of *C. setosa* is presented here based on records and illustrations from Dr. Petersen provided to me in recent years. I consider this important because the current data on *C. setosa* provided by Chambers (2000), Blake (2006), and Doner & Blake (2006) do not fully address several characters now considered to be critical for separating different species of *Chaetozone* from one another. As an example, Kędra *et al.* (2011) as part of an analysis of macrofauna from a Spitsbergen fjord, near the type-locality of *C. setosa*, elected to lump cirratulids, including what they believed to be *C. setosa*, into a general cirratulid category in their study because undescribed species were known to be present in the fauna. In addition to the eight new species of *Chaetozone* described in the present paper, numerous additional species are known from Europe, North and South America, Antarctica and deep-sea collections globally (Blake, unpublished; Doner, unpublished); in order to deal with these and additional taxa, it is crucial for comparative purposes to have as complete a description of the type species as possible.

Genus *Chaetozone* Malmgren, 1867

Type species: *Chaetozone setosa* Malmgren, by monotypy.

Diagnosis. Prostomium blunt to conical, peristomium elongate to short, usually lacking eye spots, with a pair of small nuchal slits or depressions at posterior edge; with a single pair of grooved dorsal tentacles arising from posterior edge of peristomium, or sometimes more posterior on an achaetous anterior segment, or rarely an anterior setiger. First pair of branchiae arising from an achaetous segment or first setiger; or sometimes with first two pairs of branchiae on a single anterior segment. Body basically thick and fusiform over many segments, rarely with middle or posterior body segments beaded or moniliform. Setae include capillaries on most setigers and acicular spines in neuropodia and/or notopodia, spines typically concentrated in posterior segments, forming distinct cinctures with spines emerging from elevated membranes; cinctures with few to many spines and with none to many alternating capillaries; some species with posterior noto- and neuropodial sigmoid acicular spines numerous, encircling entire posterior parapodia; bidentate spines sometimes present in juveniles or occasionally in ventral most position of far posterior setigers of adults accompanying unidentate spines in cinctures; some species with long, natatory-like capillaries, sometimes limited to gravid individuals. Pygidium a simple lobe, disk like, or with long, terminal cirrus.

Remarks. With an increasing number of species of *Chaetozone* being described, further details of the peristomium, anterior segmentation, position of the dorsal tentacles and branchiae, nature of the posterior cinctures and associated noto- and neuropodial acicular spines, and pygidium are changing the manner in which species of this genus are viewed. Distinct groups of species that share contrasting suites of characters are now evident. The generic diagnosis presented here is slightly altered from that of Blake (1996, 2006) but does not entirely reflect the diverse morphology now evident in this genus. Some aspects of this morphology are reviewed in the discussion at the end of this paper. The following description of the lectotype of *C. setosa* selected by Petersen (1999) is intended to better define the type-species of the genus to allow for comparison with the numerous global records referred to the species.

Description of the lectotype of *Chaetozone setosa* Malmgren, 1867

By James A. Blake and Mary E. Petersen¹

Chaetozone setosa Malmgren, 1867

Figures 1–2; Table 1

Malmgren 1867: 96, Pl. 14, Fig. 84; Petersen 1999: 111; Chambers 2000: 589–591, Fig. 1.

Material examined. Norwegian Arctic, Spitsbergen, Isfjord, 30 fathoms (55 m), coll. 06 June 1864, A.J. Malmgren syntype lot SMNH 1493: Lectotype, female, SMNH 1493-03 examined by Dr. Mary E. Petersen and designated in print (Petersen 1999); 38 Paralectotypes from SMNH 1493: 1493-01, 1493-02, 1493-04–36; data on these collections provided with illustrations, sketches, and descriptive data from preliminary manuscript by Dr. Petersen, dated 03 April 2001; eight prepared slides of parapodia and illustrations from paralectotype 1493-33 also provided by Dr. Petersen; additional study of prepared slides including preparation of photomicrographs, by J.A. Blake, September 2014.

Description. A moderately sized species, lectotype a complete ovigerous female, 20.2 mm long, 1.7 mm wide for 90 setigerous segments; complete paralectotypes up to 28 mm long, 2 mm wide for 94 setigerous segments (Table 1). Body of most preserved specimens curled into a C-shape, but not strongly coiled. Body thickened in middle, narrowing anteriorly and posteriorly. Anterior setigers short, wide, becoming up to 2 times longer in middle body segments, but always narrower than wide except for some segments on ovigerous specimens. Dorsal groove weakly developed, narrow, often limited to anterior setigers; ventral groove well-developed, visible along most of body, absent in far posterior cinctured segments. Color in alcohol brown or grey; no distinct pigmentation.

Prostomium conical, narrow, bluntly pointed anteriorly (Fig. 1A); eyes absent; nuchal organs narrow diagonal slits, not pigmented. Peristomium with two large, distinct rings best visible laterally, overlain dorsally by swollen peristomial crest with peristomial annulations weakly developed or not apparent on crest (Fig. 1A), crest overlapping prostomium anteriorly, narrowing posteriorly, extending to near anterior margin of achaetous segment

1. Deceased 07 July 2014.

1. Dorsal tentacles arising from notch at posterior margin of peristomium (Fig. 1A); first pair of branchiae typically positioned posterior to tentacles on posterior margin of incomplete achaetous segment; second pair of branchiae on setiger 1 (Fig. 1A).

Setiger 1 of approximately same size as preceding achaetous segment and subsequent setigers (Fig. 1A); parapodial lobes reduced, inconspicuous ridges in anterior and middle setigers; enlarged with elevated ridges in posterior cinctured segments bearing conspicuous armature; posterior segments separated by deeply cut intersegmental furrows and with highly elevated membranous podial lobes from which spines and capillaries emerge, forming full cinctures; notopodial spines directed ventrally, neuropodial spines directed dorsally (Fig. 2A).

Noto- and neurosetae from setiger 1, setae of anterior segments all limbate capillaries, numbering about 7–10 per fascicle (Fig. 1D); long, natatory-like notosetae present from about setiger 18–21, continuing posteriorly. Capillaries thin throughout, some with fibrils along edge, but not consistent; natatory-like setae capillaries, very long, flattened in cross section numbering 2–5 per notopodium mainly restricted to lower part of setal fascicle (Fig. 1E–F). Based on data from 16 types in Table 1, with 63–93 setigerous segments (mean = $83.9 \pm \text{SD } 7.7$), acicular spines begin from setiger 35–65 in neuropodia (mean = $51.7 \pm \text{SD } 7.6$) and setiger 43–71 in notopodia (mean = $58.7 \pm \text{SD } 7.1$). Lectotype with neuroacicular spines from setiger 57 and notoacicular spines from setiger 63 (Table 1). Spines numbering 1–3 at first, accompanied by narrow limbate capillaries, increasing to 10–13 in each ramus in fully developed and complete posterior cinctures, with 20–26 spines on a side with alternating capillaries (Fig. 1F, 2A); spines sometimes overlapping at dorsal midline; when long natatory-like setae occur within posterior cinctures, they accompany ventral-most notopodial spines and sometimes dorsal-most neuropodial spines (Fig. 1E–F). Spines brownish or brassy in appearance, round in cross section with weak narrow notch at point of emergence, with slightly curved or sigmoidal shape narrowing to a bluntly pointed tip (Figs. 1B–C, 2B–D); shafts with thick borders and fine internal striations.

Last few cinctured setigers tapering to narrow posterior end; pygidium with terminal anus and small flattened ventral lobe.

Methyl Green staining pattern. MG stains the peristomial area with heavy to sparse concentrations of small rows or stripes of stained cells, sometimes very intense; a pattern of stripes on anterior thoracic segments and posterior cinctured segments are most prominent on the ventral surface, but are not intersegmental.

Biology. The syntype collection comes from coastal fjords and shelf depths around Spitsbergen of 20–60 fathoms (36.5–110 m), in clayey or muddy sediments. Numerous specimens were observed with oocytes in various stage of maturity (Table 1); largest ova observed were 120–125 μm in diameter (SMNH 1493-09). Some males confirmed with sperm platelets (Table 1).

Remarks. *Chaetozone setosa* is readily distinguished from most related species by having a separate achaetous segment anterior to setiger 1 that bears the first pair of branchiae in combination with an enlarged dorsal swelling or crest on the peristomium. In addition, acicular spines of *C. setosa* begin in the posterior third of the body and have fully developed cinctures in the far posterior parapodia with 22–24 spines on each side. Further, *C. setosa* has a MG staining pattern that includes stain on the peristomium and ventral segmental stripes in anterior and far posterior parapodia. Other species of *Chaetozone* described with an inflated lobe or crest overlying the peristomium as in *C. setosa* include: *C. corona* Berkeley & Berkeley, 1941, *C. pugettensis* Blake **n. sp.**, *C. platycera* Hutchings & Murray, 1984, and *C. carpenteri* McIntosh, 1911.

Chaetozone corona is readily distinguished from *C. setosa* and other species by having the neuropodial acicular spines from setiger 1 and a pair of black eyes. *Chaetozone pugettensis* **n. sp.**, described in the present study, most closely resembles *C. setosa* in the nature of the two large peristomial rings that are overlain dorsally by a variably inflated dorsal ridge or crest (See comments for *C. pugettensis* **n. sp.**). *C. setosa* differs from *C. pugettensis* **n. sp.** in that long natatory-like capillaries are present on all specimens examined including the posterior cinctures, whereas no specimens of *C. pugettensis* **n. sp.** have been observed with these setae. Another important difference is that *C. setosa* has a distinct MG staining pattern, whereas *C. pugettensis* **n. sp.** has none. *Chaetozone platycera* from New South Wales, Australia is another species with an inflated lobe or crest overlying the peristomium, however, in this species distinct peristomial annuli were not observed (Hutchings & Murray 1984). Unlike *C. setosa*, the noto- and neuroaciculars of *C. platycera* begin on anterior setigers (~23 in notopodia; ~47 in neuropodia on specimens with ~200 setigers) instead of the posterior third and have 11–13 spines per side posteriorly instead of 22–24. *Chaetozone carpenteri* is an unusual Mediterranean species in that long, enlarged and elongate noto- and neuropodial acicular spines first appear in anterior setigers 6–9, continuing to about the middle body segments; from there the spines become narrower, but remain long and alternate with thin capillaries in far posterior cinctures (Chambers *et al.* 2011).

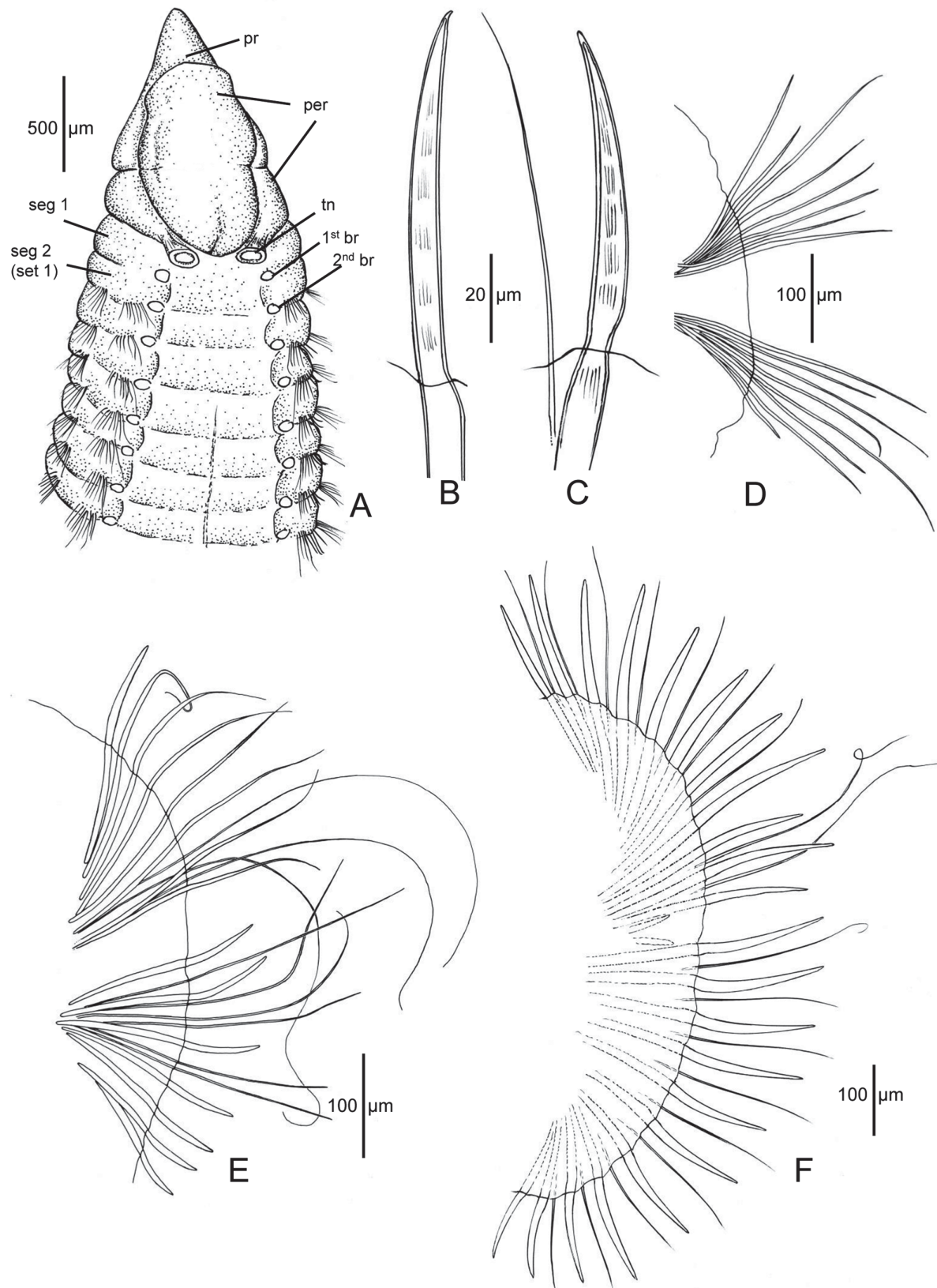


FIGURE 1. *Chaetozone setosa* Malmgren, 1867. A, anterior end, dorsal view; B, posterior notoacicular seta; C, posterior neuroacicular seta and capillary; D, right setiger 12, posterior view; E, right setiger 59, posterior view; F, right setiger 78, posterior view. (A, redrawn from a sketch prepared by M.E. Petersen of the lectotype (SMNH 1493-03); B–C, originals of acicular setae by J.A. Blake from slide mount of setiger 78 prepared by M.E. Petersen from paralectotype SMNH 1493-33); D–F, originals by M.E. Petersen from paralectotype SMNH 1493-33.

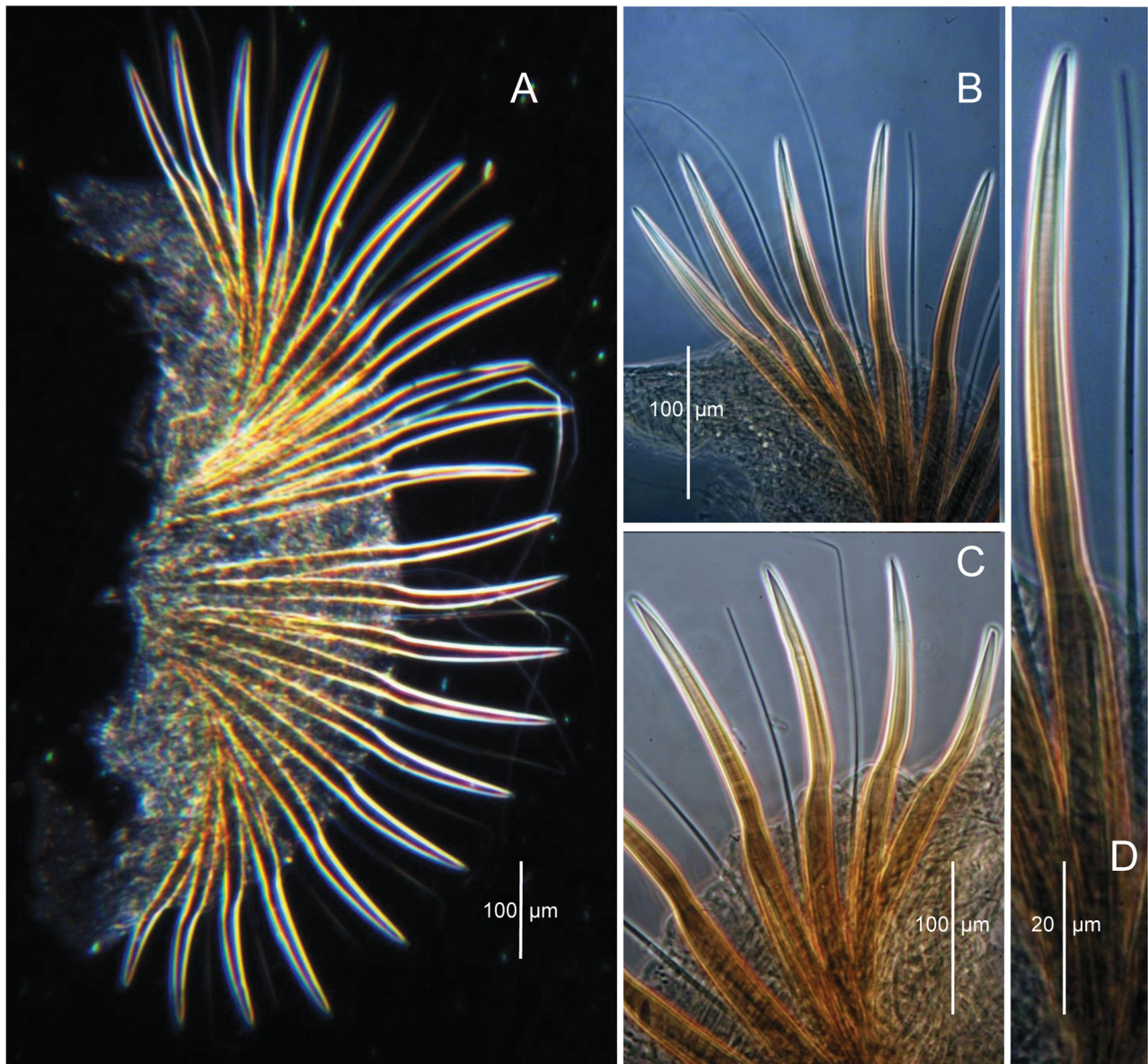


FIGURE 2. *Chaetozone setosa* Malmgren, 1867. A. Right setiger 78, anterior view; B, detail of some notoacicular spines and capillaries from same; C, detail of some neuroacicular spines and capillaries from same; D, detail of neuroacicular. (All photographed by J.A. Blake from slide mount of setiger 78, prepared by M.E. Petersen from paralectotype SMNH 1493-33).

Distribution. Pending further study of historical records, *C. setosa* is here limited to Arctic and subarctic areas around Spitsbergen and other areas of northern Europe in shelf depths of 30–110 m. Dr. Petersen's notes indicate that the species was also found offshore East Greenland in muddy sediments.

Description of new species of *Chaetozone* and *Tharyx* from the North American Arctic and Northeastern Pacific

Chaetozone pigmentata new species

Figures 3–4

Chaetozone setosa: Pettibone 1954, p. 287–288, in part (not Fig. 33d = *Tharyx alaskensis* n. sp); Pettibone 1956: p. 562; Blake & Dean 1973, p. 34, in part. Not Malmgren 1867.

TABLE 1. Data on the lectotype and 15 paralectotypes (all complete specimens) from the Malmgren syntype collection examined by Dr. Mary E. Petersen.

| Specimen (SMNH #) | Sex | Length/ Width (mm) | No. Setigers | 1 st Neuro- Aciculars (setiger) | 1 st Noto- Aciculars (setiger) | Maximum No. aciculars (d/v); Setiger from last (-#) | Notes |
|-------------------------|----------|-----------------------|-----------------|--|---|---|--|
| Paralectotype (1493-01) | Indet | 17.9/1.7 | 85 | 40 | 51 | Not determined | Oocytes: 50–72 µm |
| Paralectotype (1493-02) | Female | 20.4/1.4 | 89 | 65 | 70 | Not determined | Eggs: 75–100 µm |
| Lectotype (1493-03) | Female | 20.2/1.7 | 91 | 57 | 63 | 10/10 (-13) | Eggs: 75–100 µm |
| Paralectotype (1493-04) | Indet | 19.3/1.3 | 87 | 48 | 53 | Not determined | Gametes not observed |
| Paralectotype (1493-05) | Female | 20.4/2.0 | 86 | 54 | 62 | 11/11–12 (-6) | Oocytes: 85–120 µm |
| Paralectotype (1493-06) | ?Male | 28.3/2.0 | 93 | 55 | 64 | 12/12 (-15) | Gametes not observed |
| Paralectotype (1493-07) | Female | 20.4/2.0 | 74 | 54 | 60 | Not determined | Oocytes: 95–100 µm; regenerating posteriorly |
| Paralectotype (1493-08) | Juvenile | 13.4/1.0 | 63 | 35 | 43 | 8/8 (-5) | Gametes not observed |
| Paralectotype (1493-09) | Female | 20.4/1.7 | 89 | 56 | 58 | 11+12/11+11 (-12) | Eggs: 120–125 µm on surface of body or just under surface |
| Paralectotype (1493-10) | Female | 16.2/1.5 | 76 | 46 | 54 | 9–10/10–11 (-10 & -11) | Oocytes: 70–85 µm |
| Paralectotype (1493-11) | Female | 22.7/2.0 | 86 | 56 | 62 | 13/11 (-15) | Oocytes: 85–100 µm |
| Paralectotype (1493-12) | Indet | 18.8/1.3 | 91 | 62 | 71 | 9/11 (-11) | Gametes not observed |
| Paralectotype (1493-13) | ?Male | 19.3/2.0 | 80 | 52 | 58 | 10/10 (-13) | Gametes not observed |
| Paralectotype (1493-14) | Male | 23.2/1.9 | 86 | 47 | 53 | 10/11 (-12) | Sperm platelets |
| Paralectotype (1493-15) | Male | 16.2/1.5 | 81 | 49 | 57 | Not determined | Sperm platelets |
| Paralectotype (1493-16) | Female | 18.8/1.9 | 86 | 52 | 59 | 9/11 (-13) | Oocytes: 70–85 µm |

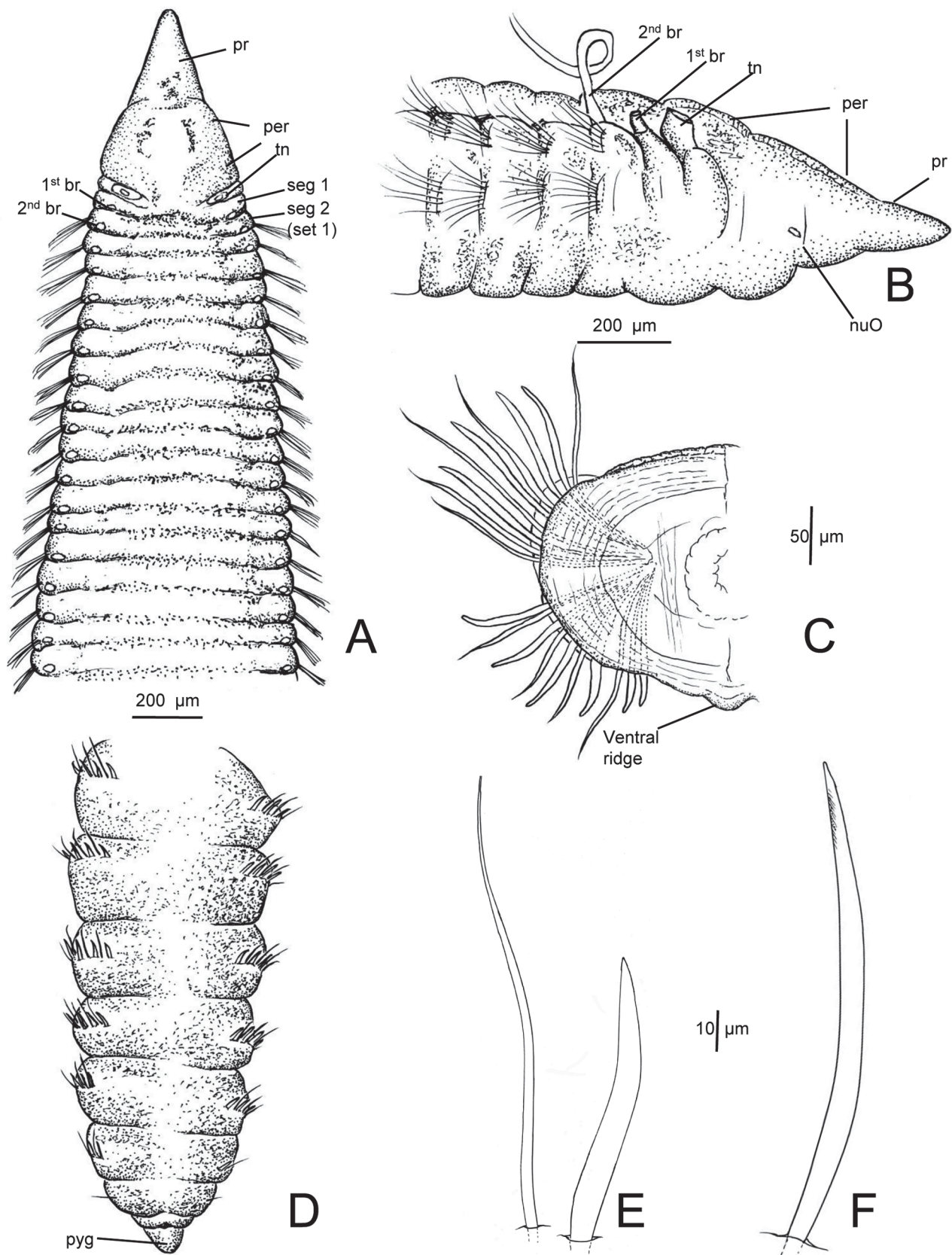


FIGURE 3. *Chaetozone pigmentata* n. sp. Paratypes (USNM 51221): A, anterior end, dorsal view; B, anterior end, right lateral view; C, far posterior parapodium, anterior view; D, posterior end, dorsal view; E, neuropodial acicular spine and capillary from far posterior segment; F, notopodial acicular spine from far posterior segment. (All paratypes, USNM 51221).

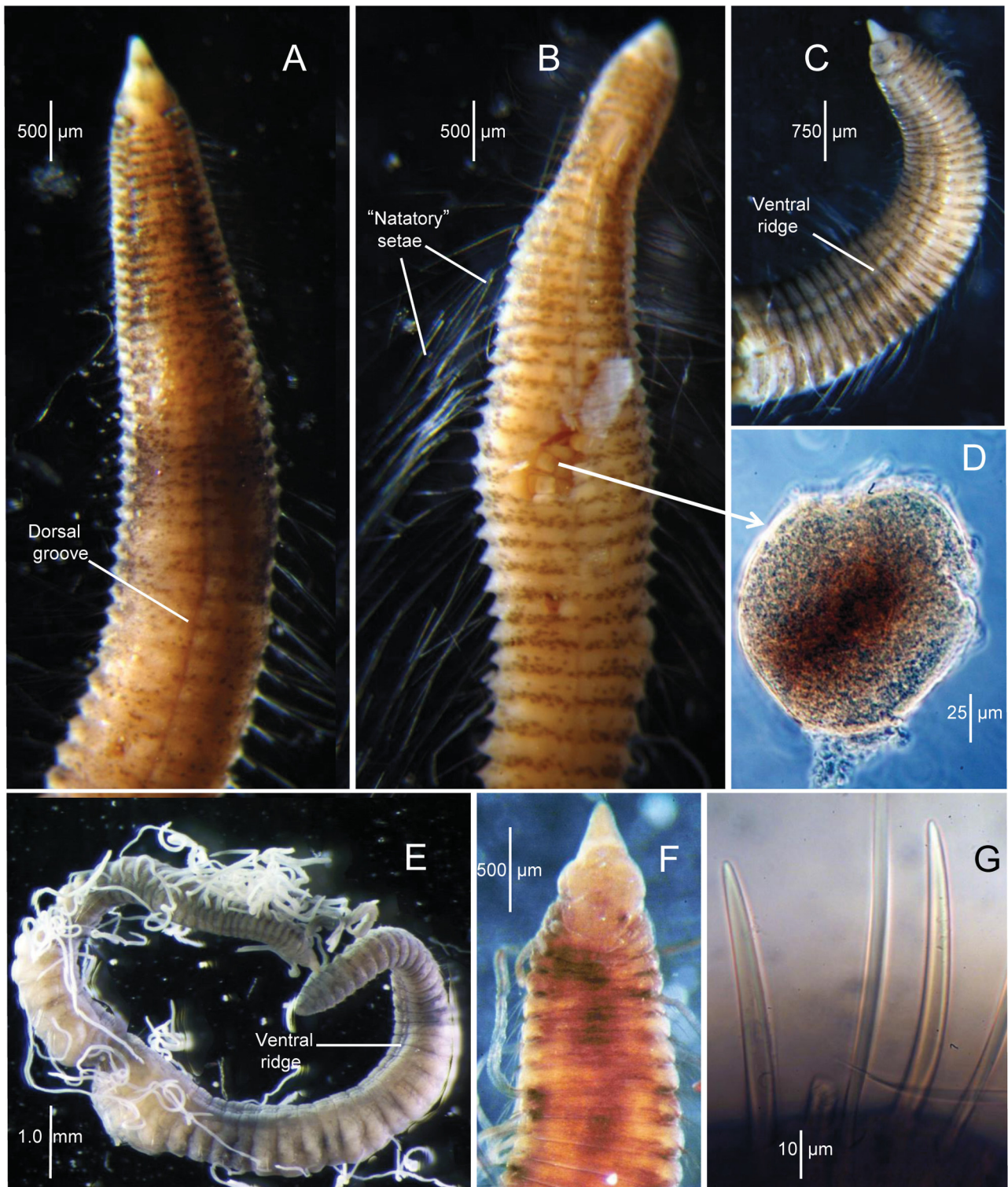


FIGURE 4. *Chaetozone pigmentata* n. sp. Photomicrographs, Paratypes (USNM 51221): A, anterior end, dorsal view; B, anterior end, ventral view showing natatory setae and with cut showing eggs in coelom; C, another specimen in ventral view showing ventral ridge line; D, egg removed from coelom of specimen in 2B; E, entire specimen from Pt. Barrow collection in lateral view, showing ventral ridge line; F, anterior end, dorsal view; G, posterior neuropodial acicular spines. (All paratypes, USNM 51221; A–B, F, stained with Shirlastain A).

Material examined. Canadian Arctic, offshore Baffin Island, East Angiak Island, R/V *Hero* Sta. 20, 132–245 m, 65°43'N, 62°05'W, coll. J.A. Blake, 14 Aug 1968, holotype (USNM 51221), 45 paratypes (USNM 1263246).—Off Labrador, Hebron Fjord, *Blue Dolphin* Sta. 27, 174 m, 58°11.4'N, 62° 34.2'W, coll. D.C. Nutt, 8

Aug 1949, Otter trawl, mud bottom, 16 specimens (USNM 22815); Sta. 28, 229 m, 58°09'N, 62°45.7'W, coll. D.C. Nutt, 8 Aug 1949, Otter trawl, 30+ specimens (USNM 22816).—**Alaskan Arctic, Off Point Barrow**, 104 m, offshore, coll. G.E. McGinitie, 11 Oct 1949, dredged, rocks, stones, gravel, 1 specimen (USNM 22803); 138 m, offshore, coll. G.E. McGinitie, 11 Oct. 1949, dredged, rocks and stones, 1 specimen (USNM 22804); 128 m, 7 mi offshore, coll. G.E. McGinitie, 09 Aug 1949, dredged, stones and gravel, 3 specimens (USNM 22805); 138 m, 8 mi offshore, coll. G.E. McGinitie, 11 Oct 1949, dredged, rocks, stones, gravel, 4 specimens (USNM 22806); 66 m, 7.5 mi offshore, coll. G.E. McGinitie, 6 September 1949, dredged, removed from rock and growth on rock, 4 specimens (USNM 22807); 226 m, 12.1 mi offshore, coll. G.E. McGinitie, 17 Aug 1950, dredged, mass of worm tubes, 1 specimen (USNM 22808); 38 m, offshore, coll. G.E. McGinitie, 09 Sep 1948, dredged, 1 specimen (USNM 22809); 40 m, offshore, 4 miles out, coll. G.E. McGinitie, 09 Aug 1949, stones, gravel, from surface of tunicates, 1 specimen (USNM 22811); 36.5 m, offshore, coll. G.E. McGinitie, 15 Sep 1948, 2 specimens (USNM 22813).

Description. A moderately sized species, holotype complete, 8.2 mm long, 0.8 mm wide across setigers 15–30, for 80 setigerous segments. Some complete paratypes up to 14 mm long, 1.2 mm wide for about 100 setigers; largest specimens from Baffin Island collection. Body widest in anterior 15–30 setigers, narrowing posteriorly; all anterior thoracic segments short, crowded, at least 15–20 times wider than long; middle body segments of some specimens larger, inflated on some specimens; posterior segments narrow, about 4–5 times wider than long. A weakly developed narrow dorsal groove runs along body from about setiger 30 (Fig. 4A); a prominent ventral ridge formed of ventromedial bulges arising from each segment runs along entire length of body (Figs. 3C, 4C, E); this feature present in all specimens examined. Color in alcohol light brown with body segments covered with numerous brown to black pigment speckles imparting distinctive background coloration to most specimens (Figs. 3A–B; 4A–C, F); in some paratypes this pigment becomes prominent on prostomium and peristomium, forming bands across dorsum of some anterior segments, and often concentrated between segments; some specimens very darkly pigmented.

Prostomium triangular, narrowing anteriorly to rounded tip (Fig. 3A); without eyes, with nuchal organ narrow slit on posterior margin of prostomium, sometimes pigmented resembling eyes (Fig. 3B); peristomium with one large and one narrow achaetous ring, followed by an achaetous segment between peristomium and setiger 1; narrow peristomial ring incomplete dorsally, overlain medially by posterior extension of large ring; tentacles arising from narrow peristomial ring; achaetous segment similar in form to setiger 1, bearing first pair of branchiae on posterior margin; second pair of branchiae on setiger 1, dorsal to notosetae, branchiae continuing on subsequent setigers (Fig. 3A).

Anterior setae all capillaries arranged in single rows in both noto- and neuropodia; notosetae numbering 6–9 per row, neurosetae numbering 7–10 per row; about half of specimens with additional long, natatory notosetae along most of body, these specimens sexually mature with many specimens having coelom full of eggs (Fig. 4B, D). Notopodial acicular spines from setigers 30–50 in all specimens; neuropodial acicular spines from anterior third of body or setigers 12–26 in Baffin Island specimens having 50–85 total setigers and setigers 5–15 in specimens from Point Barrow and Labrador having total 29–65 setigers; neuroacicular spines 1–2 per neuropodium at first, increasing to 6–7 near posterior end of body; each neuropodial acicular spine with curved blunt-tips or weakly pointed (Figs. 3E, 4G), these alternating with capillaries; notoacicular spines 2–5 per segment, narrower and more pointed than neuroacicular spines (Fig. 1F), also with additional capillaries; noto- and neuroacicular spines and capillaries of posterior segments hooked, forming weakly developed cinctures with low membranes, leaving broad dorsal gap between opposite parapodia (Fig. 3C).

Pygidium simple, with terminal anus and single ventral lobe (Fig. 3D).

Variability. Some specimens from Point Barrow and Labrador with posterior part of first peristomial ring enlarged, bulbous, extending dorsally over two rings bearing the tentacles and first pair of branchiae; this variation is believed due to contraction during preservation. All specimens with distinct ventral line of ridges and reduced development of posterior segments; posterior segments bearing noto- and neuropodial acicular spines never developed into full cinctures as in related species, with only low parapodial membranes or none evident. Neuropodial acicular spines begin earlier in the Point Barrow and Labrador specimens, on setigers 5–15 vs. setigers 12–26 in the Baffin Island specimens. This difference appears to be size related, with larger Baffin Island specimens having spines beginning later, suggesting a replacement of spines by capillaries with growth. However, all specimens have acicular spines first appearing in the anterior third of the body.

Methyl Green staining pattern. No pattern.

Remarks. Based on available collections, *Chaetozone pigmentata* **n. sp.** is the only species found to range across the entire North American Arctic. While there is some variability, all of these specimens share several unique features not found in other species encountered as part of this study. These features include a heavily pigmented body, a prominent mid-ventral ridge line that extends along the entire body, a very weak mid-dorsal groove in middle body segments, the first occurrence of the neuropodial acicular spines in the anterior one-third of the body (setigers 5–26) with the smallest specimens having spines in anteriormost locations and the overall distribution being size dependent, and most importantly a reduced posterior armature of spines where the parapodia have only weakly developed cinctures and parapodial membranes. *C. pigmentata* **n. sp.** bears some resemblance to *C. brunnea* Blake, 2009 from deep-sea sediments off California in the nature of the peristomium and presence of body pigment. However, *C. brunnea* has an unusual body shape denoted by an enlarged and often dark mid-body stomach; in addition, *C. brunnea* has an achaetous segment bearing two pairs of branchiae instead of one pair and the posterior spines are more numerous and formed into well-developed parapodial cinctures more typical of most *Chaetozone* species. Some specimens of *C. pigmentata* **n. sp.** also have enlarged mid-body segments, but these appear to be associated with reproductive development. *C. pigmentata* **n. sp.** is readily distinguished from other *Chaetozone* species by the heavily pigmented body, weakly developed posterior cinctures with a reduced number of spines, the unusual ventral ridge with mid-ventral segmental bulges, and separate achaetous segments with the first bearing tentacles and the second bearing the first pair of branchiae.

Biology and ecology. Some Baffin Island specimens have eggs 120–125 µm in diameter (Fig. 4D). Sediments at the collecting locality consisted of well-sorted brown-grey sticky mud with a mean particle size of 150 µm. In addition to *C. pigmentata* **n. sp.**, 16 other polychaete species were identified (Blake & Dean 1973). Of these, *Galathowenia oculata* (Zachs, 1923) was the most abundant followed by *C. pigmentata* **n. sp.** and *Myriochele heeri* (Malmgren, 1867). Labrador specimens were found within mud-filled *Pectinaria* tubes; Point Barrow specimens were dredged from bottoms with stones and gravel.

Etymology. The species name is based on the pigment spots found on the bodies of all specimens.

Distribution. Widely distributed across the North American Arctic, Baffin Island, Labrador, and the Beaufort Sea, offshore Point Barrow, in shelf depths of 38–245 m.

Chaetozone bathyala new species

Figures 5–6

Chaetozone setosa: Blake & Dean 1973, in part. Not Malmgren 1867.

Material examined. Canadian subarctic: Western Hudson Strait, CSS *Hudson* cruise 90-023, Sta. 100, collected between 23 September and 16 October 1991, van Veen grab, 63°04.07'N, 74°34.00'W, 393 m, Western Hudson Strait, holotype (LACM-AHF Poly 6535), 19 paratypes (LACM-AHF Poly 6536). **Southern Baffin Bay,** R/V *Hero* Sta. 26 A, 1745 m, 67°49'N, 60°46'W, coll. J.A. Blake, 16 Aug 1968, 8 specimens (USNM 51222).

Description. A moderate-sized species, holotype complete, 11.5 mm long, 0.8 mm wide across thoracic region, with 80 setigerous segments; all paratypes incomplete but of similar size as holotype. Body widest anteriorly, with short, crowded segments (Figs. 5A–B, 6A), narrowing posteriorly with segments becoming nearly as long as wide (Fig. 6D); one of two ovigerous paratypes with abdominal segments nearly moniliform, with body widest anteriorly, narrow crowded segments at least 8–10 times wider than long; segments then becoming about as wide as long in middle body with posterior segments narrowing to about 3–4 times wider than long. Without any distinct dorsal groove along body; with weak ridge along ventral midline (Figs. 5B, 6B). Color in alcohol light brown with anterior segments sometimes with black pigment pattern (Fig. 6A), faded in other specimens; Baffin Bay specimens more darkly pigmented.

Prostomium triangular, narrowing to pointed anterior end (Figs. 5A–B, 6A–C), without eyes; nuchal grooves on posterior margin of prostomium, sometimes pigmented in Baffin Bay specimens. Peristomium complex, with three incomplete anterior annulations producing two relatively large achaetous rings and a narrower posterior ring bearing dorsal tentacles (Fig. 5A–B); peristomium extending posteriorly to setiger 1, overlying a narrow achaetous segment bearing first pair of branchiae (Fig. 5A); second pair of branchiae on posterior margin of setiger 1 dorsal and medial to notosetae, subsequent setigers with branchiae arranged in same manner.

Neuropodial acicular spines first appear in anterior third of body: setigers 20–25 on the 80-setiger holotype and setigers 18–20 on an incomplete 50-setiger paratype; spines single at first, then increasing to 3–4 in middle and posterior segments, and up to 10–12 per neuropodium in far posterior cinctured setigers. Notopodial acicular spines first present in far posterior setigers, rapidly increasing to 8–10 per notopodium in far posterior cinctures; cinctures fully developed, with elevated membranes. Acicular spines numbering 18–22 per posterior parapodium, alternating with thin capillaries in dorsal-most and ventral-most positions in notopodia and neuropodia of cinctures, respectively (Fig. 5C–D). Individual spines somewhat geniculate, curving toward narrow, bluntly pointed tip; internal striae clearly visible; alternating capillaries narrow (Figs. 5E, 6F). Two paratypes with long notopodial natatory-like capillaries (Fig. 6D) and distended abdominal segments with coelom packed with ova; ova measuring up to 156 μm in longest dimension (Fig. 6G), but average proportions of 137 x 106 μm ; other 18 paratypes without natatory-like capillaries or any evidence of gametes.

Pygidium with terminal anal opening and with short, protruding dorsal lobe (Figs. 5C, 6E).

Methyl Green staining pattern. With distinct MG staining pattern on prostomium and peristomium; all of prostomium except tip staining, with most of peristomium staining forming “mask” over the head region (Fig. 6C), with grooves separating peristomial rings either staining poorly or not at all.

Biology and ecology. Based on currently available material, *C. bathyala* **n. sp.** is limited to deep, cold waters in the Canadian Arctic from 383 to 1745 m. Specimens from shallower depths are referred to other species. The Hudson Strait survey report by McLean *et al.* (1991) has only limited information on the results of the grab sampling. Sediments are noted to consist of sand and mud, but no actual grain size information is included. The fauna to a depth of 400 m includes several bivalves, polychaetes, and echinoderms, but only bivalves were identified, not specific to any one station. The specimens from southern Baffin Bay, R/V *Hero* Station 26 were recorded in Blake & Dean (1973). Bottom temperatures were 0.1°C and sediment consisted of thick sticky mud. The most abundant polychaetes occurring with *C. bathyala* **n. sp.** were *Aricidea suecica* Eliason, 1920 (Paraonidae), *Cryptosclerocheilus baffinensis* Blake, 1972 (Scalibregmatidae), and *Jasmineira schudiinni* Augener, 1912 (Sabellidae).

Remarks. *C. bathyala* **n. sp.** is similar to the type species, *C. setosa*, in the nature of the peristomium, anterior achaetous segments, fully developed cinctures of posterior spines, and in having a MG staining pattern. However, *C. setosa* has not been observed with body pigmentation and the ventral surface has a deep groove instead of a ridge; further, *C. setosa* has capillaries alternating with all spines in the cinctures, whereas *C. bathyala* **n. sp.** has them limited to the upper and lower parts of the noto- and neuropodia, respectively. In addition, *C. setosa* has long, natatory-like setae present in all specimens, whereas in *C. bathyala* **n. sp.** they are limited to sexually mature specimens. *C. bathyala* **n. sp.** closely resembles *C. pigmentata* **n. sp.**, also described in this paper, in having a narrow peristomial ring bearing the dorsal tentacles, followed by the first pair of branchiae on a subsequent achaetous segment and the second pair of branchiae appearing on setiger 1. Both species bear body pigment, but in *C. pigmentata* **n. sp.** it consists of numerous speckles or patches instead of the diffuse dusky pigment of *C. bathyala* **n. sp.** Further, *C. bathyala* **n. sp.** has full posterior cinctures of spines with up to 18–22 spines on a side, whereas *C. pigmentata* **n. sp.** has only weak cinctures with no more than 11 spines on a side. *C. bathyala* **n. sp.** has a MG staining pattern, whereas *C. pigmentata* **n. sp.** has none. The pygidium of *C. bathyala* **n. sp.** differs from other species of the genus in having a small dorsal lobe overlying the anal opening instead of the distinct ventral lobe or disk found in most species of *Chaetozone*.

Among specimens examined by the late Dr. Mary E. Petersen from the collections of the Swedish Museum of Natural History (SMNH) was a single incomplete 39-setiger specimen collected off Newfoundland at coordinates 52°05'N, 52°19'W, in sand at a depth of 294 m (SMNH 1451). Dr. Petersen's notes indicate that this specimen was a female with brown pigment on the anterior dorsum to about setiger 17, being darkest on setigers 4–16. The first neuroacicular spines were on setiger 30 and increased to three or four by setiger 39; notoacicular spines were not yet present and natatory-like capillaries were absent although oocytes were present and measured 85 μm in diameter. These characteristics are mostly consistent with those of *C. bathyala* **n. sp.** except for the lack of natatory-like capillaries on a female with eggs.

Etymology. The epithet is derived from the Greek, *bathys*, for deep, denoting the bathyal depths from which this species was collected.

Distribution. Canadian Arctic and subarctic, in deep water of the Hudson Strait, 393 m and offshore, Baffin Bay, 1745 m; likely record from offshore Newfoundland in 294 m.

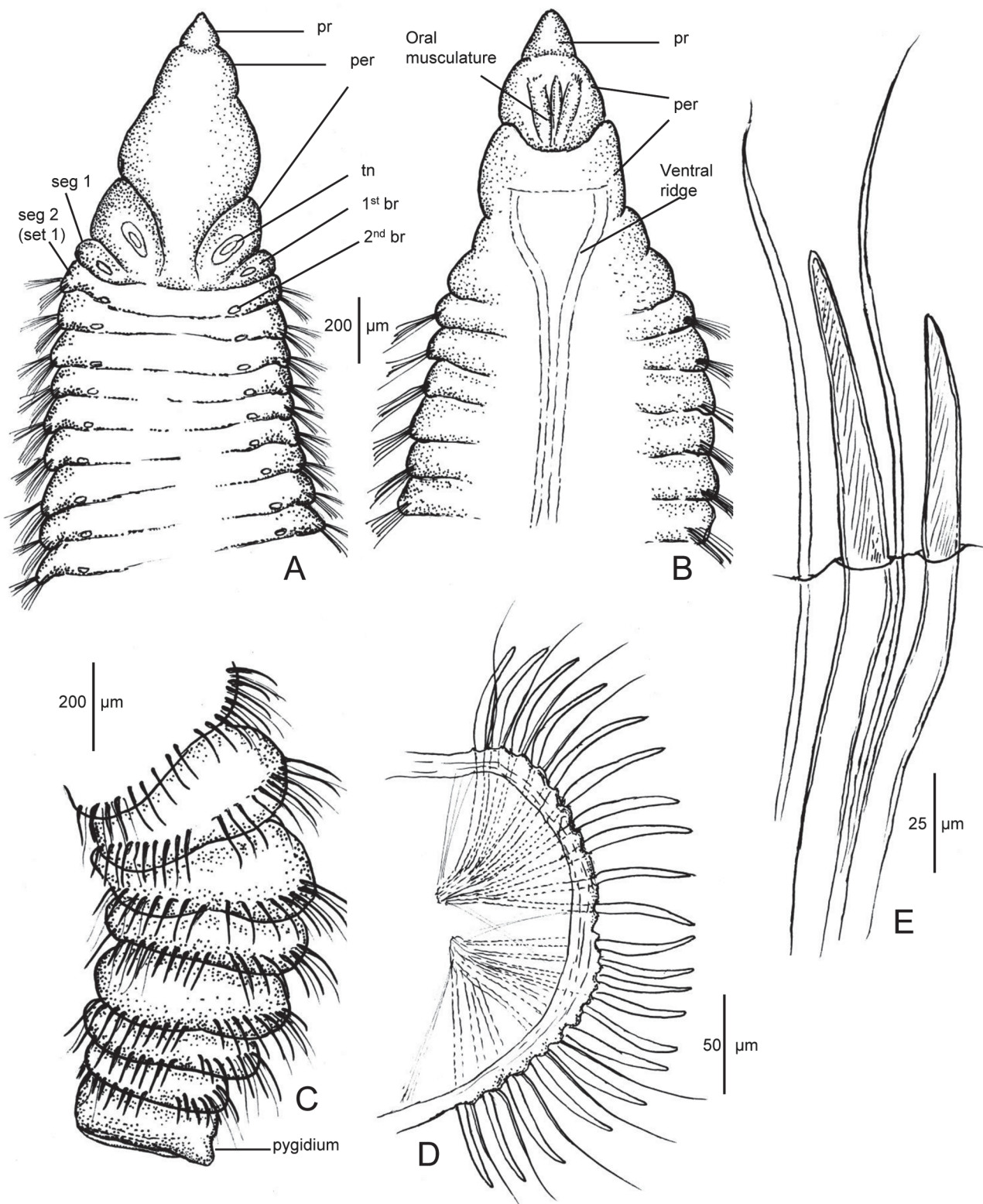


FIGURE 5. *Chaetozone bathyala* n. sp. A, anterior end, dorsal view; B, anterior end, ventral view; C, posterior end, lateral view; D, far posterior parapodium, anterior view; E, detail of posterior neuropodial acicular spines and capillaries. (A–C, holotype, LACM-AHF Poly 6535; D–E, paratype, LACM-AHF Poly 6536).

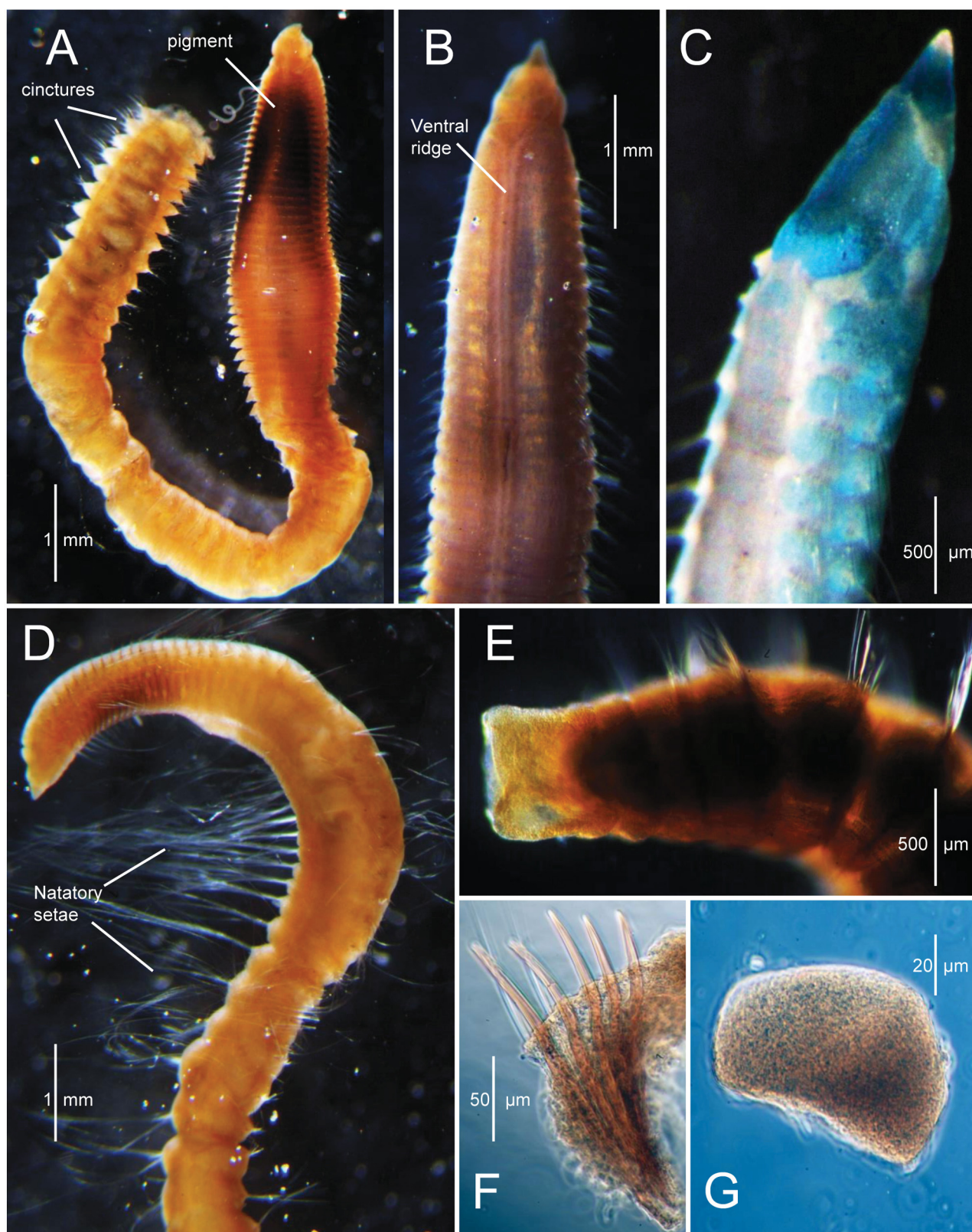


FIGURE 6. *Chaetozone bathyala* n. sp. Photomicrographs: A, entire animal, dorsal view; B, anterior end, ventral view; C, anterior end, right lateral view, showing MG staining pattern; D, anterior end, lateral view; E, posterior end, lateral view; F, posterior neuropodial acicular spines; G, oocyte. (A–D, F, paratype, LACM-AHF Poly 6536; E, holotype, LACM-AHF Poly 6535; A–B, D–E, stained with Shirlastain A; C, stained with MG).

Chaetozone careyi new species

Figures 7–8

Chaetozone setosa: Carey *et al.* 1984: 99, 103. Not Malmgren 1867.

Chaetozone sp. Goldsmit *et al.* 2014, Table 1S.

Material examined. **Alaskan Arctic, Beaufort Sea**, coll. off Pitt Point, 20 May 1976, 71°19'N, 152°38.5'W, 55 m, 0.1 m² Smith-McIntyre grab, Bell 205 helicopter, Sta. PPB-55, coll. A.G. Carey Jr., holotype (LACM-AHF Poly 6537), 1 paratype (LACM-AHF-Poly 6538); **Beaufort Sea**, coll. off Narwhal Island, 28 Aug 1976, 70°24.3'N, 147°29.2'W, 10 m, 0.1 m² Smith-McIntyre grab, R/V *Aluminak* Sta. NIB-15, coll. P.A. Montagna, 10 paratypes (LACM-AHF-Poly 6539).—**Canadian subarctic, Hudson Strait, Deception Bay, Quebec**, coll. J  sica Goldsmit, Sta. 4B, 02 Aug 2012, 62°13.187'N, 74°52.187'W, intertidal, in sand, 5 specimens (CMNA 2014-0015); Sta. 3D, 02 Aug 2012, 62°30.137'N, 74°48.614'W, 6.7 m, in sand and silt, 2 specimens (CMNA 2014-0016).

Description. A moderate-sized species, holotype complete, 11 mm long, 0.6 mm wide across thoracic region, with 118 setigerous segments; most paratypes complete, smaller than holotype; Deception Bay specimens of similar size, up to 11 mm long, 0.8 mm wide, for 90 setigers. Body relatively sleek in appearance, not expanded in anterior region, consistent in width along most of body, narrowing in far posterior setigers. Dorsal surface of body with weak longitudinal groove (Fig. 8A), venter with distinct groove along entire length of body (Fig. 8B). Color in alcohol light tan with no body pigment.

Prostomium triangular, acutely pointed on anterior margin (Figs. 7A, 8A); eyes absent; nuchal organs not pigmented, narrow slits at posterior lateral margin of prostomium; peristomium elongate, with 3–4 rings (Fig. 7A); peristomium extending dorsally over achaetous segment 1; dorsal tentacles arising over segment 2 (setiger 1) (Figs. 7A, 8A); first pair of branchiae arising from achaetous segment 1; second pair of branchiae arising from segment 2 (setiger 1) lateral to paired medial dorsal tentacles and dorsal to notosetae; branchiae continuing on subsequent setigers (Fig. 7A, 8A).

Anterior noto- and neurosetae all simple capillaries arranged in single rows of 5–6 notosetae and neurosetae; capillaries increasing to 6–8 per noto- and neuropodium in middle body segments. Some middle body parapodia with natatory-like capillary setae.

Neuropodial acicular spines first present from setigers 60–65, or about posterior one-third of body; notopodial acicular spines from about setiger 90 or near posterior end; spines single at first, then increasing to 5–7 in notopodia and 7–10 in neuropodia; spines forming distinct cinctures in posterior segments, with moderately developed elevated membranes and up to 17 spines on a side (Figs. 7C, 8D). All acicular spines in cinctured segments alternating with long, thin capillaries; each spine thickened basally, curved, and tapered to blunt tip (Figs. 7D, 8E).

Pygidium with elongate ventral lobe (Figs. 7B, 8C).

Methyl Green staining pattern. No pattern.

Remarks. The characteristic that most defines *C. careyi* n. sp. is a shift in the position of the paired dorsal tentacles posteriorly over the first setiger and posterior to the first pair of branchiae. In most species of *Chaetozone*, including the other species described in this paper, the tentacles arise posteriorly on the peristomium but well anterior to the first branchiae and any of the setigerous segments. The situation in *C. careyi* n. sp. is similar to but not as extreme as that in *C. bansei* Blake, 1996, where the first tentacles are shifted posteriorly to setigers 4–7. *C. careyi* n. sp. and *C. bansei* are also similar in the cinctured posterior setigers, shape of the acicular spines, and the nature of the pygidium. However, *C. careyi* n. sp. further differs from *C. bansei* in lacking thickened anterior capillaries and a MG staining pattern, which is characteristic of *C. bansei*. In addition, in *C. bansei* the neuropodial acicular spines begin on setigers 28–29 or the anterior third of the body, whereas in *C. careyi* n. sp. they begin on setigers 60–65 or near the posterior third of the body; notoacicular spines begin about setiger 80 in *C. bansei* and setiger 90 in *C. careyi* n. sp. Originally described from shallow shelf depths offshore San Francisco, California, *C. bansei* ranges north to at least off Oregon (Blake unpublished), whereas *C. careyi* n. sp. appears to be limited to the North American Arctic and subarctic.

In correspondence and among the notes and illustrations left by Dr. Mary E. Petersen, was data on specimens of a species of *Chaetozone* from the Aleutian Islands, Dutch Harbor, Alaska coll. 30 September 1980, from shallow water grab samples provided by the University of Alaska, Fairbanks. These specimens were attributed to *C. bansei* by Dr. Petersen and were noted to have the dorsal tentacles shifted posteriorly over an anterior setiger and with the

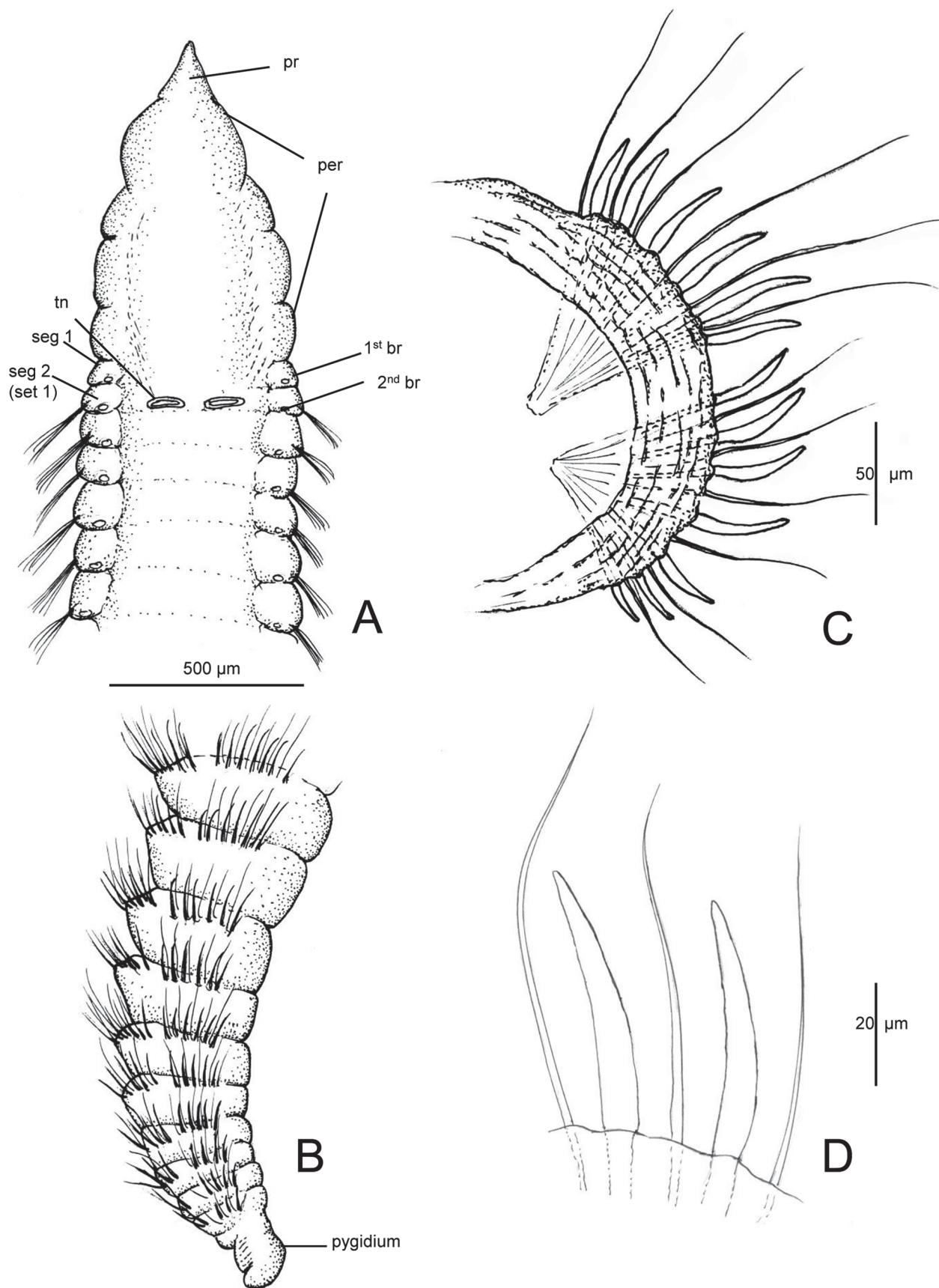


FIGURE 7. *Chaetozone careyi* n. sp. A, anterior end, dorsal view; B, posterior end, lateral view; C, far posterior parapodium, anterior view; D, posterior neuropodial acicular spines and capillaries. (A–B, holotype, LACM-AHF Poly 6537; C–D, paratype LACM-AHF Poly 6538).

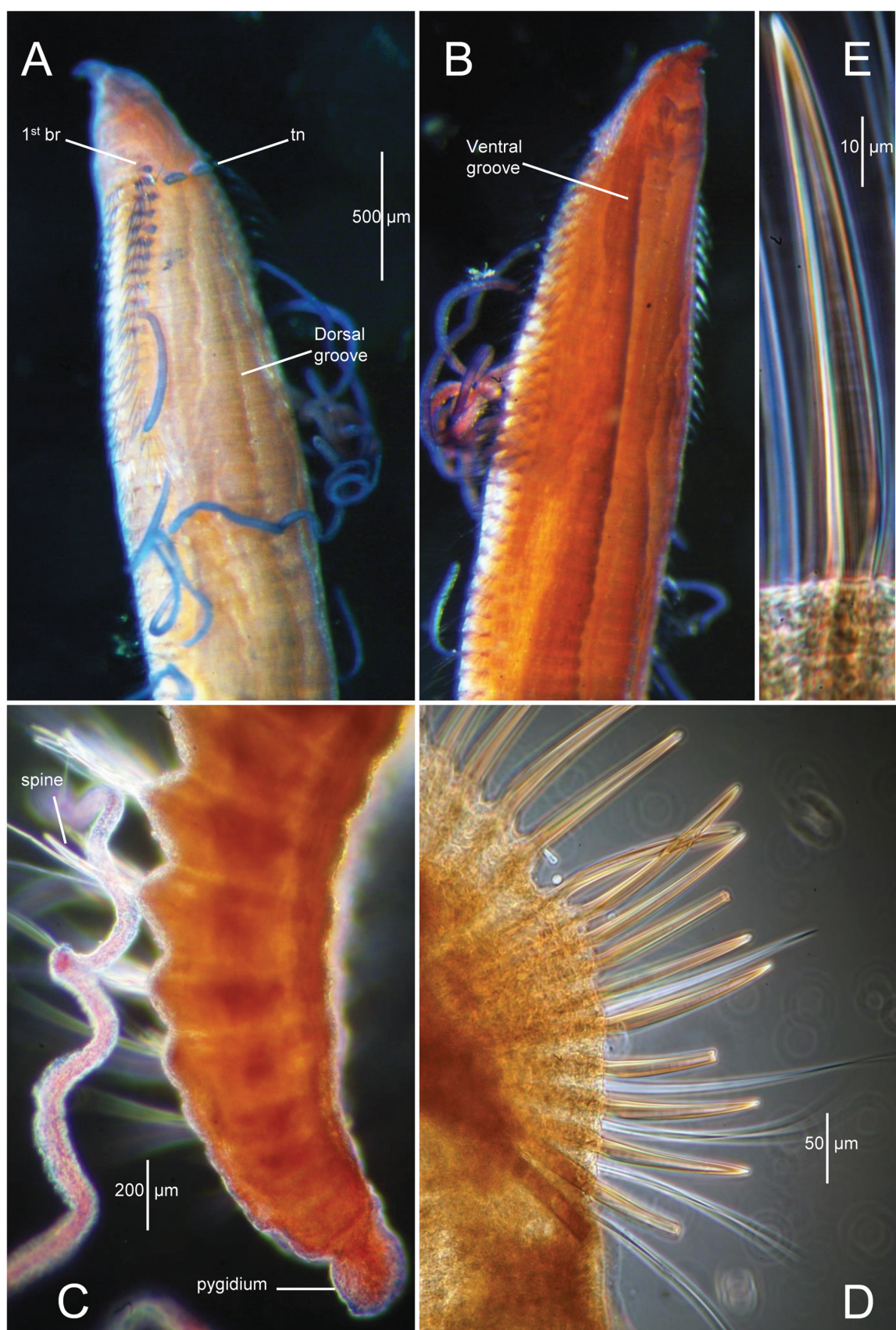


FIGURE 8. *Chaetozone careyi* n. sp. Photomicrographs: A, anterior end in dorsolateral view; B, anterior, ventral view; C, posterior end lateral view; D, part of far posterior parapodium showing acicular spines; E, neuropodial acicular spine from far posterior setiger. (A–B, holotype, LACM-AHF Poly 6537; C–E, paratype, LACM-AHF Poly 6538; A–D, stained with Shirlastain A).

neuroaciculars from the posterior third of the body instead of the anterior third in *C. bansei*. This information agrees well with the characters of *C. careyi* n. sp. described here.

Biology and Ecology. The data from the Beaufort Sea project is only available in a report to the U.S. government (Carey *et al.* 1984). From this, *C. careyi* (as *C. setosa*) was part of an assemblage dominated by a suite of polychaetes including *Capitella* sp., *Chone* cf. *murmanica* Lukasch, 1910, *Prionospio cirrifer* Wirén, 1883, and *Pholoe minuta* (Fabricius, 1780).

Etymology. This species is named for Dr. Andrew (Drew) G. Carey, Oregon State University, Corvallis, Oregon, benthic ecologist and friend. Dr. Carey's surveys in the Alaskan Arctic and in deep-sea habitats inspired several students, some of whom have developed their own careers in benthic ecology and taxonomy.

Distribution. Known from the Beaufort Sea, Alaska, to Hudson Strait, Canada, in shallow depths; Aleutian Islands; intertidal to 55 m.

***Chaetozone ruffi* new species**

Figures 9–10

Chaetozone setosa: Busdosh 1984. Not Malmgren 1867.

Material examined. Alaskan Arctic, Beaufort Sea, Prudhoe Bay, 05 Aug 1983, 70°23.9'N, 148°26.0'W, 3 m, push cores, coll. M. Busdosh, Waterflood 6 project, R/V *Annika Marie*, Sta. 15-1, holotype (LACM-AHF Poly 6540), 3 paratypes (LACM-AHF Poly 6541).

Description. A moderate-sized species, holotype 12 mm long, 1.0 mm wide with 96 setigerous segments; paratypes similar in size with 90–100 setigers. Body expanding slightly in anterior segments, narrowing gradually along body; posterior third of body with full cinctures of spines. Middle body dorsoventrally flattened, with deep ventral groove continuing to near posterior end; mid-dorsal groove present along most of body (Figs. 9A, 10A–B), becoming deeper and more distinct in posterior setigers where elevated membranes and cinctures of spines overlap and enhance groove. Color in alcohol light tan with no body pigment.

Prostomium narrow, pointed on anterior margin (Fig. 9A–B), with slit-like nuchal organ on posterolateral margin (Fig. 9B); eyes absent. Peristomium broad, with 2–3 weak annulations, forming one large anterior ring and two narrow posterior rings; all rings weakly defined (Fig. 9A–B) and variable in size and development between specimens; distinct achaetous segment not apparent; last peristomial ring bearing tentacles and first pair of branchiae, with latter arising lateral to tentacles (Fig. 9A–B). Second pair of branchiae arising from setiger 1, continuing on subsequent segments; branchiae of anterior third of body long, thick, branchiae of middle and posterior segments, short and thin where present.

Anterior noto- and neurosetae all simple capillaries arranged in single rows of 6–8 notosetae and neurosetae; capillaries increasing in middle body segments to 15 or more in notopodia and 10–12 in neuropodia; some capillaries long, but extremely long natatory-like capillary setae absent in mature individuals.

Neuropodial acicular spines from setigers 56–57 or posterior third of body, first spines single, in ventral-most position in fascicle, then increasing to 9–11 over next 20–22 setigers replacing all but dorsal-most capillaries; very thin capillaries appearing in last 15 or so posterior-most segments, alternating with spines. Notopodial acicular spines from setigers 58–65, with first spines in dorsal-most location of fascicle, increasing to 9–11 posteriorly, but not replacing capillaries as in neuropodia, instead, capillaries retained and alternate with spines but become very thin in far posterior cinctures. Posterior segments with well-developed elevated membranes and 10–11 spines in both noto- and neuropodia, forming full cinctures on each segment, with notosetae overlapping at dorsal midline (Fig. 10B–D). All cinctured segments with spines alternating with long, thin capillaries; each spine thickened basally, curving, tapering to blunt tip (Figs. 9D–E, 10D–E); notopodial spines generally longer than neuropodial spines, with neuropodial spines in ventral-most position shorter, curved, weakly geniculate.

Pygidium with terminal anus and small, rounded ventral lobe (Figs. 9C, 10C).

Methyl Green staining pattern. No pattern.

Biology and ecology. This species occurred in shallow, sandy silt sediments of Prudhoe Bay. Other commonly associated invertebrates included the polychaetes *Tharyx alaskensis* n. sp., *Marenzellaria viridis* (Verrill, 1873), *Prionospio cirrifer*, *Ampharete vega* (Wirén, 1883), and the amphipod *Monoporeia affinis* (Lindström, 1855). Coelomic oocytes present in the holotype and paratypes, ca. 60–80 µm in longest dimension.

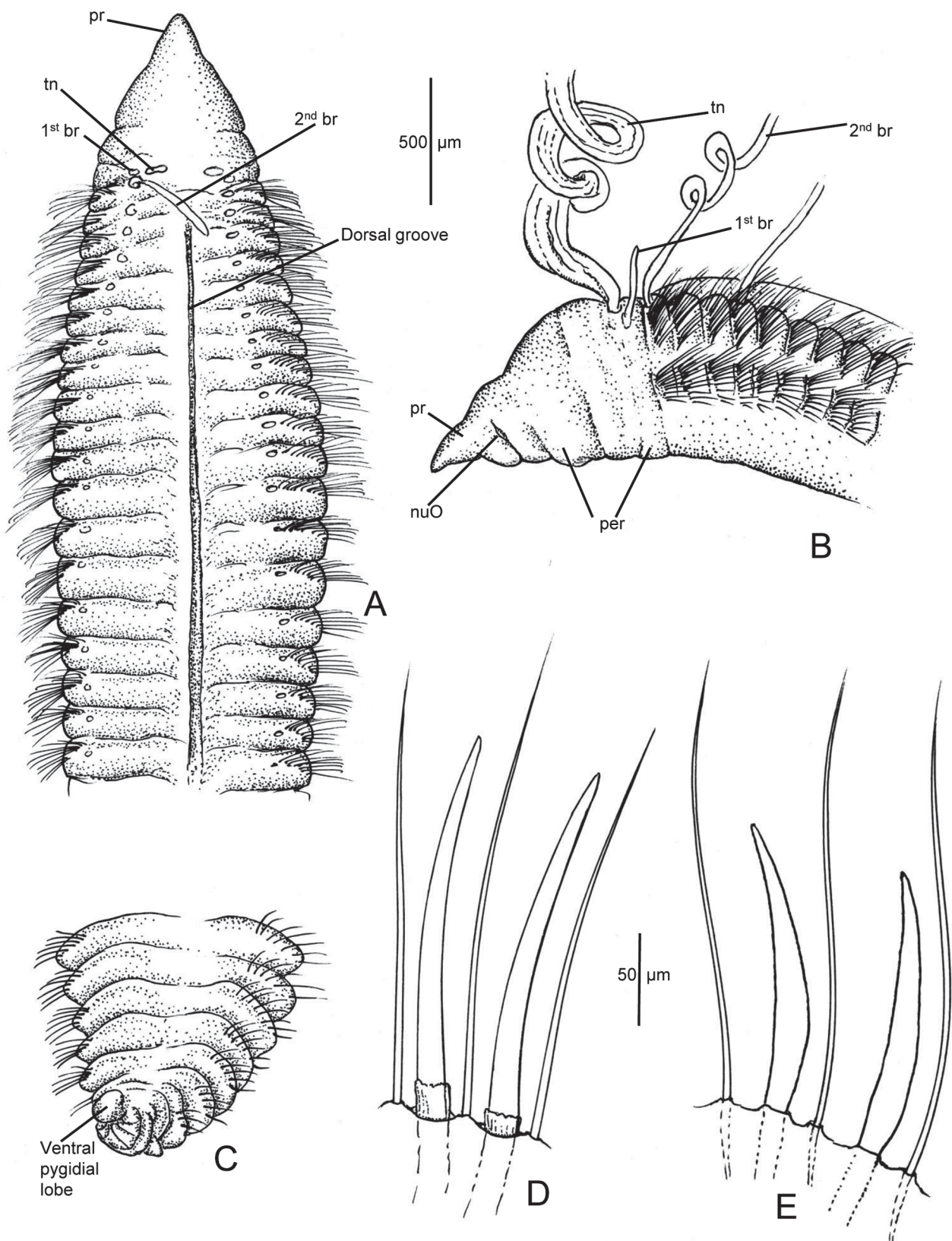


FIGURE 9. *Chaetozone ruffi* n. sp. Paratypes: A, anterior end, dorsal view; B, anterior end, lateral view; C, posterior end, ventral view; D, notopodial acicular spines and capillaries from far posterior segment; E, neuropodial acicular spines and capillaries from far posterior segment. (paratypes, LACM-AHF -Poly 6541).

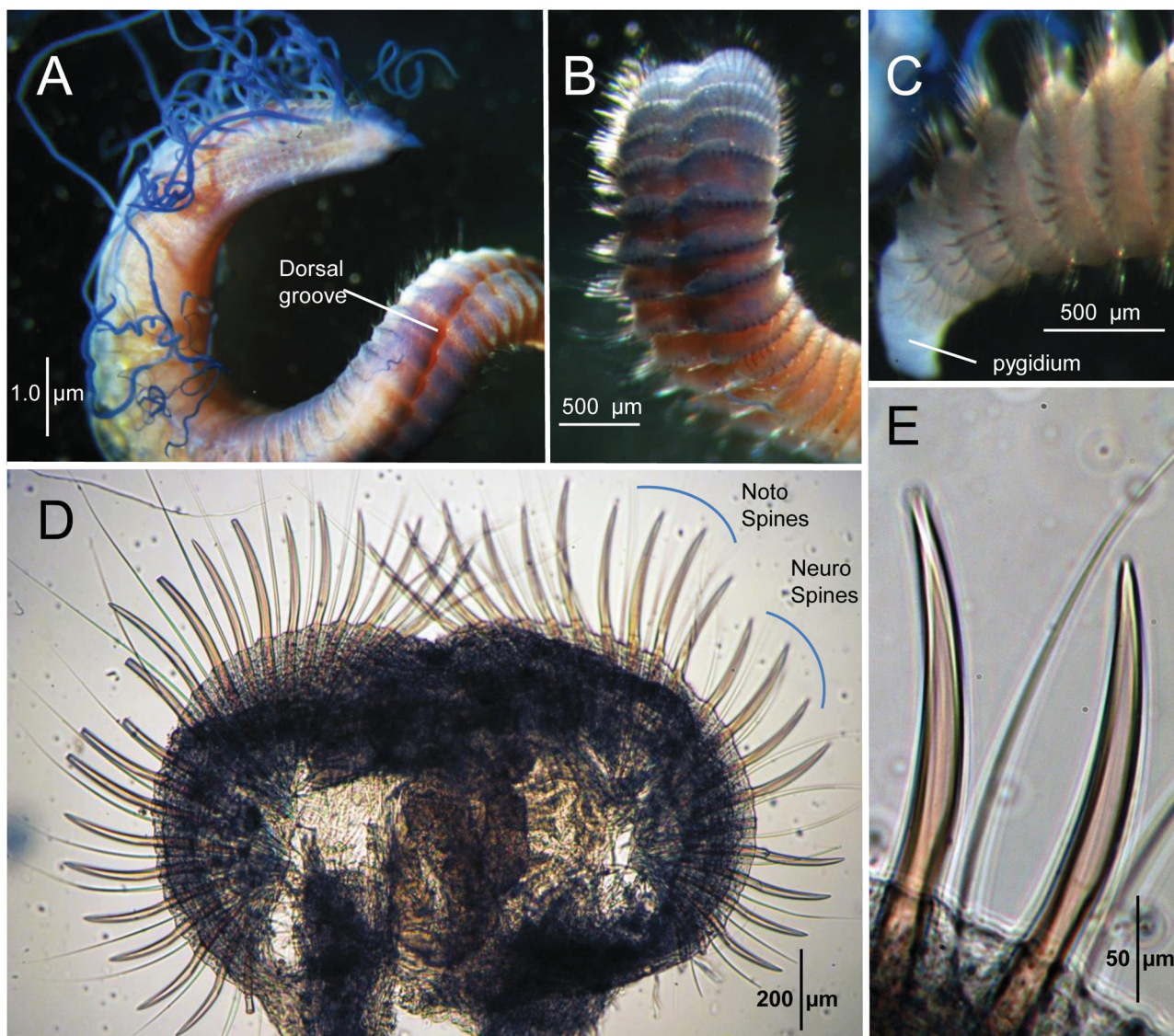


FIGURE 10. *Chaetozone ruffi* n. sp. Photomicrographs: A, anterior fragment in dorsolateral view; B, posterior end, dorsal view showing posterior cinctures and deep dorsal groove; C, posterior end in lateral view showing pygidium; D, entire posterior setiger in anterior view. (A, D–E, paratypes, LACM-AHF Poly 6541; B–C, holotype, LACM-AHF Poly 6540; A–C, stained with Shirlastain A).

Remarks. Due to weakly developed peristomial annuli, a distinct achaetous segment between the peristomium and setiger 1 could not be discerned in *Chaetozone ruffi* n. sp.; therefore, both the paired tentacles and first pair of branchiae are interpreted as arising from the posterior margin of the peristomium. Both the neuropodial and notopodial spines begin in the posterior third of the body rather than more anteriorly as is typical for related species. The posterior cinctures form highly modified posterior segments in this species; the notopodial spines and notopodial membranes overlap mid-dorsally enhancing the dorsal groove.

Among species known from the NE Pacific and the North American Arctic, the species closest to *C. ruffi* n. sp. are *C. columbiana* Blake 1996 from off Oregon and Washington and *C. hobsonae* n.sp. from British Columbia and SE Alaska. Each of these species lack a distinct achaetous segment anterior to setiger 1 and the dorsal tentacles and first pair of branchiae arise from the posterior margin of the peristomium. *Chaetozone ruffi* n. sp. has up to 22 posterior acicular spines on each side; *C. columbiana* has 11–12; and *C. hobsonae* n. sp. has 17–19. Further, both *C. columbiana* and *C. hobsonae* have distinctive MG staining patterns while *C. ruffi* n. sp. has none. In lacking a distinct achaetous segment that can be discerned on the peristomium, *C. ruffi* n. sp. is also similar to *C. hystricosa* Doner & Blake, 2006, from off New England; however, *C. hystricosa* has only 12–13 acicular spines on each side in posterior setigers, whereas *C. ruffi* n. sp. has up to 22 acicular spines.

Etymology. This species is named for my friend and long-time colleague, Mr. R. Eugene Ruff. Gene provided much of the material and data presented in this paper and contributed valuable information relative to his extensive experience with the benthos of northeastern Pacific and Alaska.

Distribution. Alaskan Arctic in shallow water, 3 m.

Chaetozone malmgreni new species

Figures 11–12

Chaetozone setosa: Blake 1996: 274–276, Fig. 8.1. Not Malmgren 1867.

Material examined. Oregon, Clatsop County, off Tillamook Head, Sta. SMG 1937, Scallops Island, 45°53.6'N, 124°11.9'W, 109 m, 0.1 m² Smith-McIntyre grab, coll. 7 Nov 1981, A.G. Carey, Jr. holotype (LACM-AHF Poly 6542), one paratype (LACM-AHF Poly 6543).

Description. A large species, two complete specimens; holotype largest, 25 mm long, 2.5 mm wide for 106 setigers; paratype 18 mm long, 1 mm wide for 82 setigers. Color in alcohol light tan to brown, lacking any distinctive body pigment. Body long, arched dorsally, with shallow, narrow, mid-dorsal groove along entire length of body (Figs. 11A, 12A), most prominent in anterior setigers, but deemphasized in far posterior segments by overlap of setae and membranes of dorsal cinctures; venter flattened, with deep prominent mid-ventral groove (Fig. 12B) continuing along entire body through cinctured posterior segments (Fig. 11F).

Prostomium long, narrow, pointed on anterior end (Figs. 11A–B, 12B, D); eyes absent; nuchal organs elongated slits on posterior margin of prostomium (Fig. 11B); peristomium with large anterior inflated buccal region followed by two narrow annulations, second annulation interpreted as an achaetous segment bearing a pair of dorsal tentacles and a pair of branchiae positioned laterally (Fig. 11A–B). Subsequent setigers with branchiae dorsal to notosetae (Figs. 11A–B, 12D); anterior branchiae thicker than those of middle segments.

Setiger 1 of approximately same size as preceding achaetous segment and following segments; podial lobes reduced to inconspicuous ridges in anterior setigers, becoming inflated and conspicuous in middle setigers, greatly enlarged with elevated ridges in posterior setigers on deeply cinctured segments bearing conspicuous armature (Fig. 12A–C); posterior segments separated by deeply cut intersegmental furrows and with highly elevated membranous podial lobes from which spines and capillaries emerge, forming full cinctures (Figs. 11F, 12A–C); small, ciliated organ present between ventral-most notopodial spine and dorsal-most neuropodial spine (Fig. 11E); notopodial spines directed ventrally, neuropodial spines directed dorsally.

Noto- and neurosetae from setiger 1 all capillaries, numbering about 6–7 per fascicle; each seta thickened, with short fibrils usually apparent along broadest edge; these capillaries remaining thick and long until far posterior setigers. Acicular spines first present from setigers 20–35 in neuropodia and 40–45 in notopodia, numbering 2–3 at first, accompanied by an equal number of thickened capillaries; neuropodial spines numbering 8–9 per fascicle and notopodial spines numbering 7–8 per fascicle in far posterior setigers, spines forming complete setal cinctures with up to 17 spines on a side (Fig. 9F); spines accompanied by alternating thin capillaries (Fig. 11F); spines blunt-tipped, slightly curved, with weak node or notch at point of emergence from podial lobe (Fig. 11E); spines with thick borders and fine internal striations.

Last few cinctured setigers narrowing to pointed posterior end (Fig. 12A–C); pygidium with terminal anus and small flattened ventral lobe (Figs. 11C–D, 12C).

Methyl Green staining pattern. Stain imparts distinct pattern on prostomium, peristomium, and anterior parapodia (Fig. 12D). Anterior tip of prostomium unstained, then with transverse band, then clear again; peristomium lightly stained, but with deeper stain on dorsal surface of last achaetous ring. Anterior parapodia deeply stained laterally, with bands extending across venter and sometimes dorsum.

Remarks. *Chaetozone malmgreni* n. sp. is characterized by having one large and one narrow achaetous peristomial ring followed by another narrow achaetous segment that bears both the tentacles and first pair of branchiae. In addition, this species has deep dorsal and ventral grooves and a distinct MG staining pattern. Other species having the dorsal tentacles and first pair of branchiae on a single achaetous segment include *C. lunula* Blake, 1996 from northern California, *C. corona* Berkeley & Berkeley, 1941, from southern California, *C. allanotai* Blake, 2006 from deep-water offshore California, and *C. michellae* Magalhães & Bailey-Brock, 2013 from Hawaii. *C. lunula*, however, has the peristomium shifted posteriorly so that the dorsal tentacles and first pair of branchiae are at

the level of setiger 1; further differences with *C. malmgreni* **n. sp.** are that the ventral-most neuropodial acicular spine of *C. lunula* is typically bidentate and the pygidium has a terminal cirrus. *C. corona* differs from all *Chaetozone* species in North America in having neuropodial acicular spines beginning on setiger 1. *C. allanotai* belongs to a group of species having a distinct type of acicular spine where the fine tip curves back and fuses with the shaft. *C. michellae* has a deep dorsal groove along the entire body, whereas *C. malmgreni* has both a shallow dorsal groove and a deep ventral groove along the body; the two species have very different MG staining patterns.

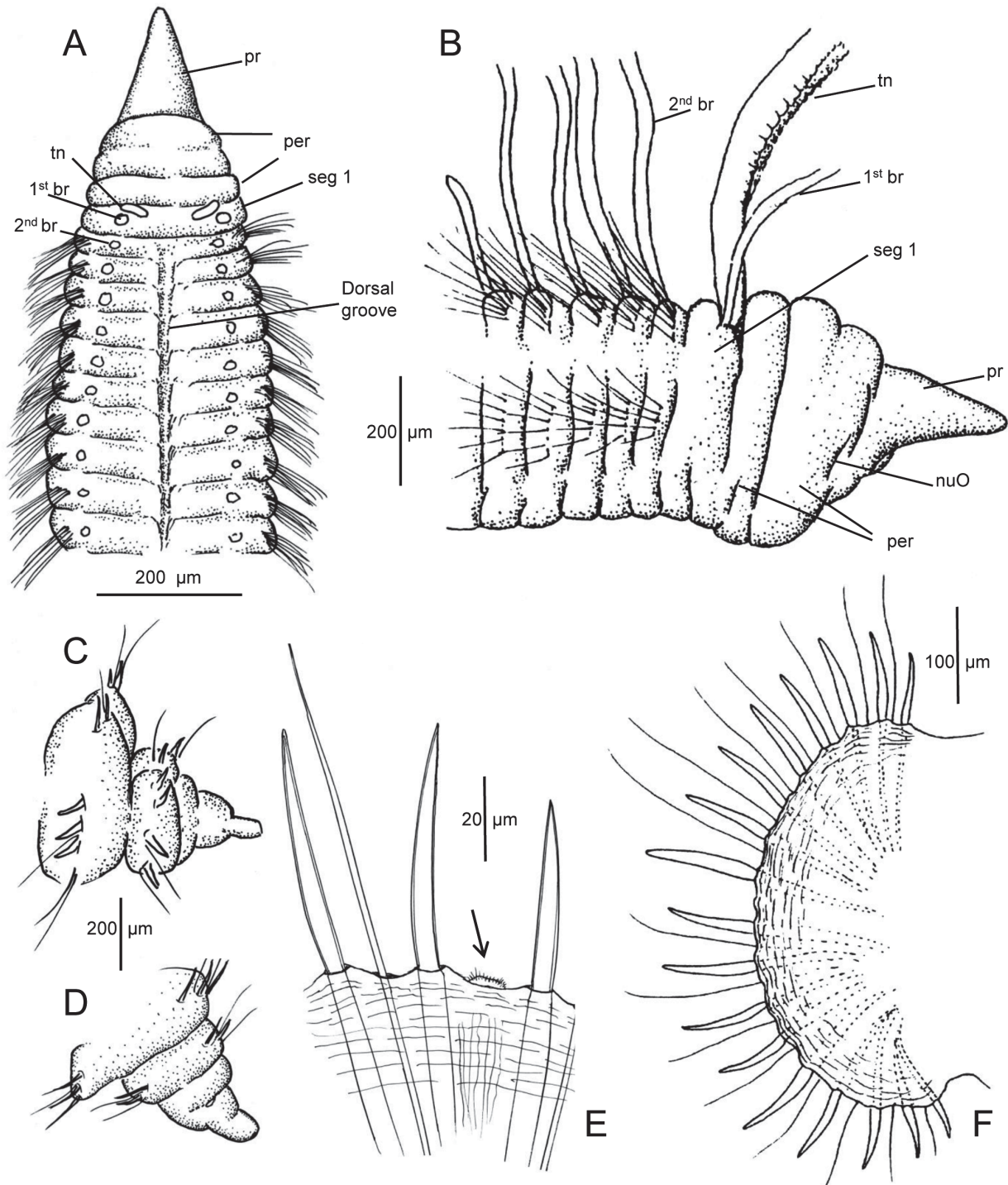


FIGURE 11. *Chaetozone malmgreni* **n. sp.** A, anterior end, dorsal view; B, anterior end, right lateral view; C–D, posterior end in different views; E, posterior noto- and neuropodial acicular spines separated by ciliated organ (arrow points to ciliated organ); F, far posterior parapodium, posterior view. (A–D, holotype, LACM-AHF Poly 6542; E–F, paratype, LACM-AHF Poly 6543).

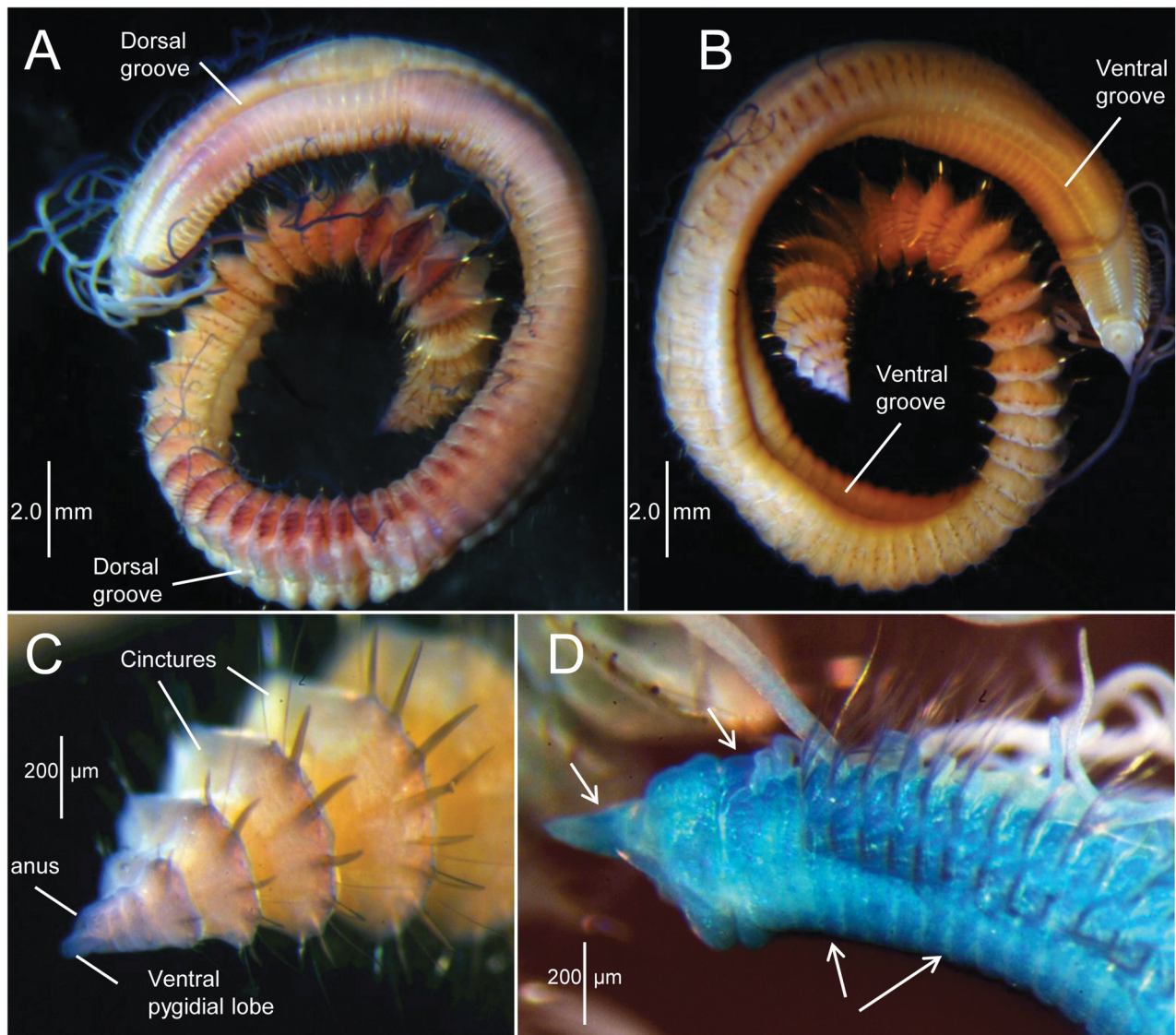


FIGURE 12. *Chaetozone malmgreni* n. sp. Photomicrographs: A–B, entire animal in different views; C, posterior end from same specimen in lateral view showing elevated parapodia and acicular spines and pygidial segment; D, anterior end, lateral view showing MG staining pattern, white arrows indicate where MG is concentrated. (A–C, holotype, LACM-AHF Poly 6542; D, paratype, LACM-AHF Poly 6543; A–C, stained with Shirlastain A; D, stained with MG).

There is also some similarity between *C. malmgreni* n. sp. and *C. anasima* Doner & Blake, 2006 and *C. hystricosa* Doner & Blake, 2006, both described from New England waters. However, both of these species have indistinct annulations on the peristomium and the exact origin of the tentacles and first pair of branchiae are vague.

Etymology. The species is named for Dr. A. J. Malmgren, who described the first species of *Chaetozone*, *C. setosa*, in his classic work on polychaetes from Greenland, Spitsbergen, Iceland, and Scandinavia in 1867.

Distribution. Known only from continental shelf sediments, offshore Oregon, 109 m.

Chaetozone pugettensis new species

Figures 13–14

Material examined. Washington, Puget Sound, San Juan Islands, Decatur Island, Puget Sound Environmental Monitoring Program (PSEMP) Spatial Survey, R/V *Kittiwake* Sta. 753, coll. 89 Jul 2012, 48°30.1315'N, 122°49.4996'W, grab, 9 m, silt and clay, holotype (LACM-AHF Poly 6544), 17 paratypes (LACM-AHF Poly 6545).

Description. A moderate-sized species, holotype and larger paratypes 12–13 mm long, 0.9–1.0 mm wide across anterior fourth of body, with 85–90 setigers. Color in alcohol light tan to brown, lacking any distinctive body pigment. Body with narrow crowded segments for two-thirds of body, without any prominent swelling or anterior enlargement (Fig. 14C–D); dorsal groove absent or weakly developed anteriorly (Fig. 13A), emphasized in far posterior segments by overlap of dorsal cinctures (Figs. 13A, 14F); venter flattened, with deep prominent mid-ventral groove continuing along entire body through cinctured posterior segments (Fig. 14B, D).

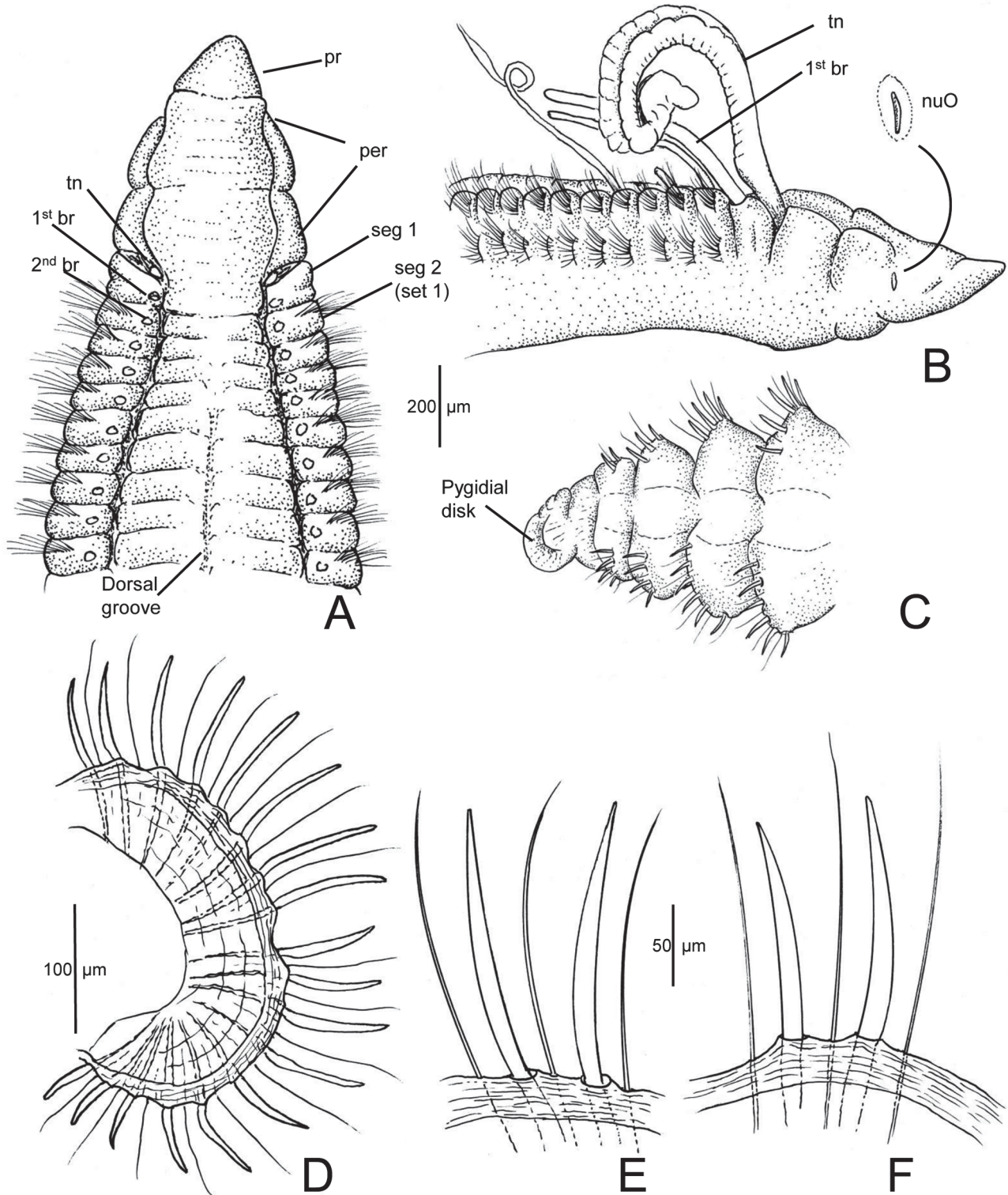


FIGURE 13. *Chaetozone pugettensis* n. sp. A, anterior end, dorsal view; B, anterior end, right lateral view; C, posterior end, dorsal view; D, posterior parapodium, anterior view; E, detail of posterior notopodial acicular spines and capillaries; F, detail of posterior neuropodial acicular spines and capillaries. (All paratypes LACM-AHF Poly 6545).

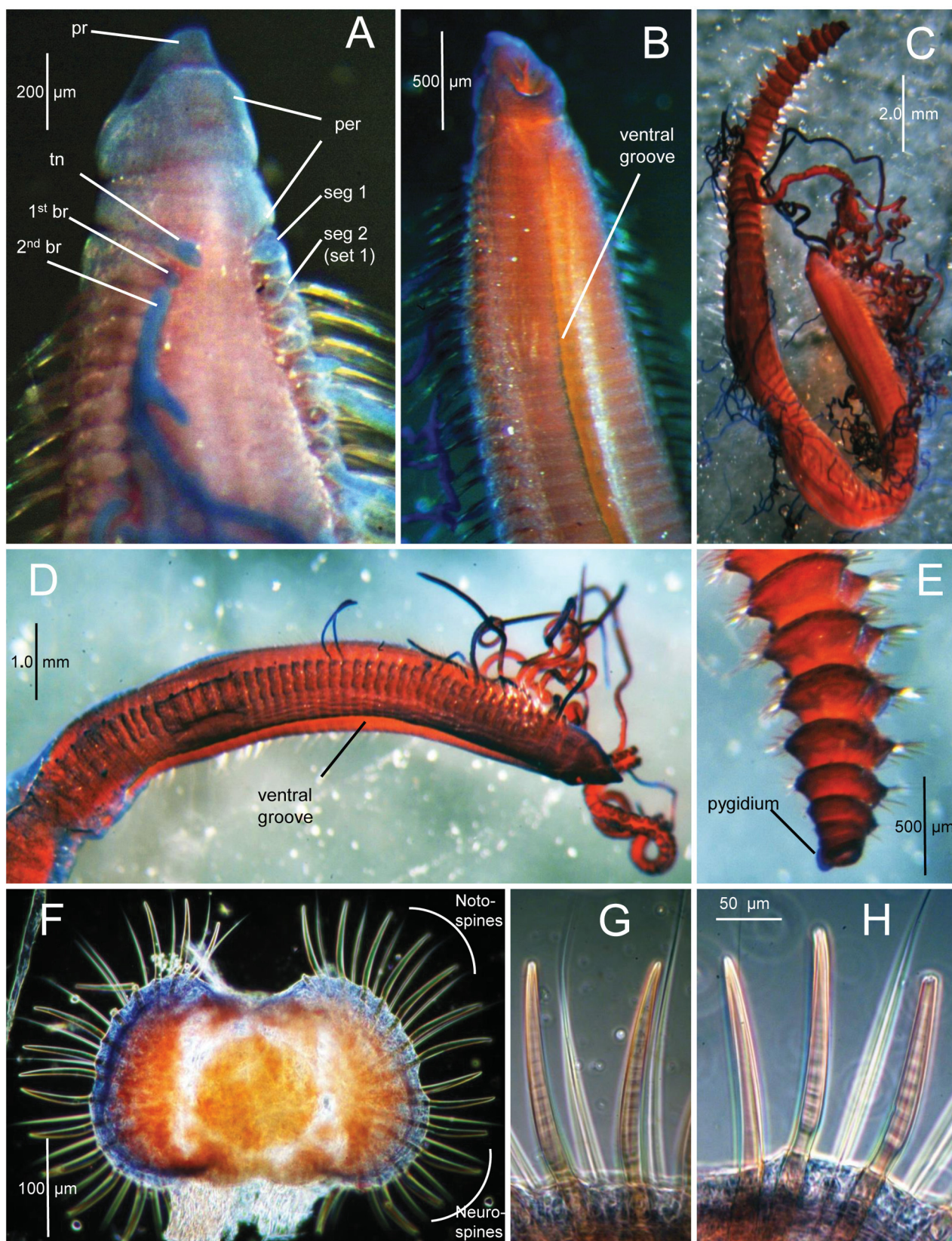


FIGURE 14. *Chaetozone pugettensis* n. sp. Photomicrographs: A, anterior end, dorsal view; B, anterior end, ventral view; C, entire animal; D, anterior end, right lateral view; E, posterior end showing elevated parapodia with spines and pygidial segment; F, posterior parapodium, anterior view; G, detail of posterior notopodial acicular spines and capillaries; H, detail of posterior neuropodial acicular spines and capillaries. (All paratypes LACM-AHF Poly 6545; all stained with Shirlastain A).

Prostomium broadly triangular, narrowing anteriorly to bluntly rounded tip (Figs. 13A, 14A–B); eyes absent; nuchal organ at posterior lateral margin, consisting of narrow slit, sometimes weakly pigmented (Fig. 13B). Peristomium with two large rings, both overlain dorsally by an inflated ridge or crest extending posteriorly to level of setiger 1; these peristomial rings followed by narrow achaetous segment having a similar shape as setiger 1. Dorsal tentacles arising from groove at posterior end of second large peristomial ring (Figs. 13A–B, 14A); first pair of branchiae arising posterior to tentacles on posterior margin of achaetous segment; achaetous segment approximately same size as subsequent setigers, sometimes with a lateral furrow (Figs. 13A–B, 14A); second pair of branchiae arising dorsal to notosetae on first setiger immediately posterior to achaetous segment 1 (Figs. 13A, 14A); subsequent setigers with branchiae dorsal to notosetae; branchiae of anterior setigers thicker than those in middle segments.

Setiger 1 of approximately same size as preceding achaetous segment and subsequent setigers; podial lobes reduced to inconspicuous ridges in anterior setigers; becoming inflated and conspicuous in middle setigers and greatly enlarged with elevated ridges in posterior setigers, with conspicuous armature; posterior segments separated by deeply cut intersegmental furrows and with highly elevated membranous podial lobes from which spines and capillaries emerge, forming full cinctures (Figs. 13C, 14E); notopodial spines directed ventrally, neuropodial spines directed dorsally (Fig. 14F).

Noto- and neurosetae from setiger 1 all capillaries, numbering 8–10 per fascicle; each seta thickened, with fibrils usually apparent along broadest edge; these capillaries remaining thick and long until far posterior setigers; long natatory-like capillary setae not observed; acicular spines first present from about setigers 50–53 in neuropodia and 60 in notopodia, or the posterior one-third of the body on specimens with 85–90 setigers; spines numbering 2–3 at first, accompanied by an equal number of thickened capillaries; in far posterior setigers notopodial spines numbering 8–9, and neuropodial spines numbering 9–10, formed into complete setal cinctures, with spines alternating with thin capillaries (Fig. 13D–F) with up to 19 spines on a side; spines blunt-tipped, slightly curved, with weak node or notch at point of emergence from podial lobe; with thick borders and fine internal striations (Fig. 14G–H).

Last few cinctured setigers tapering to narrow posterior end; pygidium with terminal anus and small flattened ventral plate or disk (Figs. 13C, 14E).

Methyl Green staining pattern. No distinct pattern.

Remarks. *Chaetozone pugettensis* **n. sp.** closely resembles the type species, *C. setosa* in the nature of the two large peristomial rings, overlaid dorsally by an inflated and sometimes bulbous dorsal ridge or crest; the form and placement of the achaetous segment anterior to setiger 1; position of the dorsal tentacles and first pair of branchiae; and the number and structure of the posterior spines. Both species also have the noto- and neuropodial acicular spines from the posterior third of the body and both have weakly developed dorsal grooves and well-developed ventral grooves along the body. *C. pugettensis* **n. sp.** differs from *C. setosa* in that the type species exhibits long natatory-like capillaries on most body segments including among the posterior spines whereas no specimens of *C. pugettensis* **n. sp.** in the present collection have been observed with these setae. Another important difference is that *C. setosa* has a distinct MG staining pattern, whereas *C. pugettensis* **n. sp.** has none.

Etymology. This species is named for its collection in the Puget Sound, offshore Decatur Island.

Distribution. Puget Sound, in silt and clay, shallow water, 9 m.

Chaetozone hobsonae new species

Figures 15–16

Material examined. **Canada, British Columbia**, Prince Rupert, off Ridley Island, coll. September 2012, AECOM, by P. Winchell & S. Doner, Van Veen grab: Sta. B05, 19 Sep 2012, 54°12.352'N, 130°19.966'W, 17.7 m, holotype (LACM-AHF Poly 6546), 10 paratypes (LACM-AHF Poly 6547); Sta. B09, 19 Sep 2012, 54°11.698'N, 130°18.848'W, 7.5 m, 10 paratypes (LACM-AHF Poly 6548); Sta. B23, 20 Sep 2012; 54°11.766'N, 130°18.691'W, 5.9 m, ca. 200 paratypes (LACM-AHF Poly 6549); Sta. B25, 21 Sep 2012, 54°11.949'N, 130°18.672'W, 20.1 m, 8 paratypes (LACM-AHF Poly 6550); Sta. B26, 19 Sep 2012, 54°12.070'N, 130°18.801'W, 12.4 m, 7 paratypes (CMNA 2014- 0017); Sta. B35, 21 Sep 2012, 54°12.281'N, 130°18.089'W, 26.7 m, 10 paratypes (CMNA 2014- 0018). **Southeastern Alaska**, Boca de Quadra, Cruise 3BQ, R/V *Redoubt*, Sta. 100-2, 55°19.2'N, 130°29.2'W, 95 m, coll. Dec 1979, R.L. Cimberg, Van Veen grab, 6 specimens (LACM-AHF Poly 6551).

Description. A moderate-sized species, holotype and larger paratypes 12–13 mm long, 0.6–0.7 mm wide across anterior setigers and ca. 0.8 mm wide in middle setigers, with about 80–85 setigers. Body typically breaks mid-body, hence many specimens incomplete. Color in alcohol light tan to brown, lacking any distinctive body pigment. Body with narrow crowded segments for two-thirds of body; posterior cinctured setigers not as crowded; body without any prominent swelling or anterior enlargement; with narrow, weakly developed mid-dorsal groove from about setiger 6–8, continuing posteriorly for about first third of body, not apparent posteriorly; venter flattened, with narrow ventral groove from just posterior to mouth continuing over anterior, middle, and most posterior setigers, absent from far posterior cinctured segments.

Prostomium swollen, enlarged, tapering to triangular and pointed anterior end (Fig. 15A–B); eyes absent; nuchal organ a narrow slit bordered by thickened pigmented cells, superficially appearing to be an eye (Fig. 15B). Peristomium elongate with two large rings, best seen laterally, separated from prostomium by deep lateral groove (Fig. 15A–B). Dorsal tentacles arise near posterior margin of peristomium; first pair of branchiae arising posterior to tentacles just anterior to setiger 1; second pair of branchiae on posterior border of setiger 1, dorsal to notosetae, subsequent setigers with branchiae similarly dorsal to notosetae.

Setiger 1 merging with peristomium approximately same size as subsequent setigers; podial lobes reduced to inconspicuous ridges in anterior setigers, inflated and conspicuous in middle setigers, greatly enlarged with highly elevated ridges and conspicuous armature in posterior setigers; posterior segments separated by deeply cut intersegmental furrows.

Noto- and neurosetae from setiger 1 all capillaries, numbering about 6–8 per fascicle; each seta thickened, relatively smooth, with fibrils sometimes apparent along broadest edge; these capillaries remaining thick and long until far posterior setigers; about half of specimens examined with long, thin, natatory-like notosetae beginning from about setigers 15–20 and continuing along most of body, most prominent in middle setigers. Acicular spines first present from about setiger 50 in notopodia and 35–40 in neuropodia, numbering 1–3 at first, accompanied by capillaries; in far posterior setigers notopodial spines numbering 7–8, neuropodial spines numbering 10–11, forming complete setal cinctures with 17–19 spines on a side and accompanied by alternating, long, thin capillaries (Figs. 15D, 16A); spines pointed, slightly curved, notopodial spines directed ventrally, neuropodial spines directed dorsally, spines with weak node or notch at point of emergence from podial lobe (Fig. 15E–F), with thick borders and fine internal striations (Fig. 16B–C).

Far posterior setigers narrowing, pygidium with terminal anus and small, flattened ventral disk (Fig. 15C).

Methyl Green staining pattern. Stain concentrating on dorsum of last peristomial ring and on setiger 1, some stain dorsally on setigers 2–3; some anterior setigers retaining stain ventrally.

Remarks. *Chaetozone hobsonae* n. sp. is similar to *C. columbiana* and *C. ruffi* n. sp. in that a distinct achaetous segment between the peristomium and setiger 1 is not readily apparent due to weakly developed peristomial annuli; because of this, the species is interpreted as lacking an achaetous segment. The species is however, readily recognized in benthic samples due to the triangular prostomium, the pigmented nuchal organs that sometimes resemble eyes, no apparent achaetous segment between the peristomium and setiger 1, acicular spines from mid-body segments, and fully developed posterior cinctures bearing 17–19 spines on a side, as well as a distinct MG staining pattern. Among, the three closely related species, *C. columbiana* has 11–12 spines per posterior cincture, a MG staining pattern, and a terminal cirrus on a short pygidial lobe; *C. hobsonae* n. sp. has 17–19 spines per posterior cincture, a MG staining pattern, and pygidial lobe without an cirrus; *C. ruffi* n. sp. has 20–22 spines per posterior cincture, no MG staining pattern, and a pygidial lobe without a cirrus. Further, the acicular spines of *C. hobsonae* n. sp. begin in middle body segments whereas in *C. columbiana* and *C. ruffi* n. sp., they begin in the posterior one-third of the body.

Biology and Ecology. *Chaetozone hobsonae* n. sp. was part of a rich benthic macrofaunal assemblage consisting of more than 400 species of invertebrates from shallow waters (5–30 m) off Ridley Island, Prince Rupert, BC (Blake, unpublished data). The sediments varied throughout the study area with some sites dominated by sands and others with silt; some samples had shell hash, others wood chips. The habitat diversity contributed to the high faunal diversity. The bivalve *Nutricola lordi* (Baird, 1863) was the most abundant species in the study area followed by the polychaetes *Levinsenia gracilis* (Tauber, 1879), *Mediomastus californiensis* Hartman, 1944, *Cossura pygodactylata* Jones, 1956, *Leitoscoloplos pugettensis* Pettibone, 1957, *Apistobanchus ornatus* Hartman, 1965, and *Scoletoma zonata* (Johnson, 1901).

Etymology. This species is named for the late Katharine D. Hobson, in recognition of her work on the polychaete fauna of British Columbia.

Distribution. British Columbia and SE Alaska, low water to 95 m; this species is likely more widely distributed in the northeastern Pacific (R.E. Ruff, personal communication).

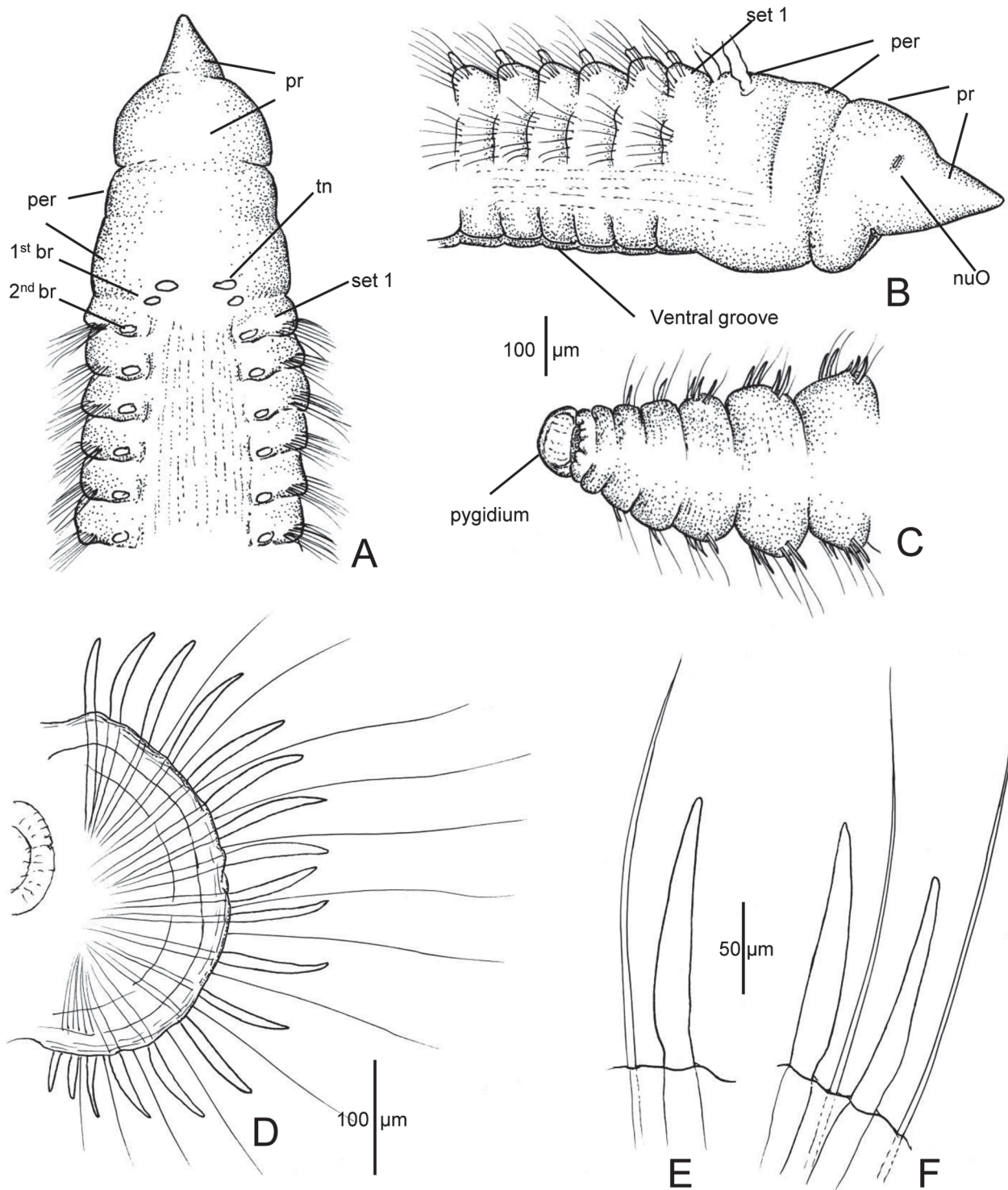


FIGURE 15. *Chaetozone hobsonae* n. sp. A, anterior end, dorsal view; B, anterior end, right lateral view; C, posterior end, dorsal view; D, parapodium from far posterior setiger, anterior view; E, detail of posterior neuropodial acicular spine and capillary; F, detail of posterior neuropodial acicular spine and capillaries. (Paratypes, Sta. 25, LACM-AHF Poly 6550).

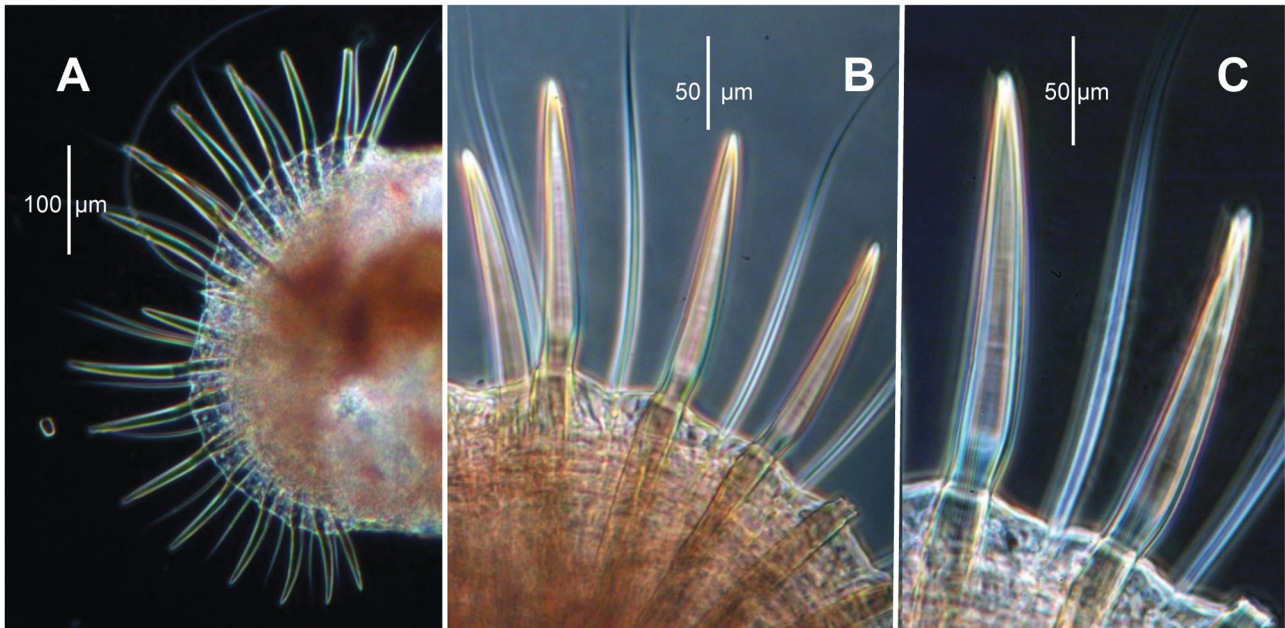


FIGURE 16. *Chaetozone hobsonae* n. sp. Photomicrographs: A, posterior parapodium, anterior view; B, detail of posterior notopodial acicular spines and capillaries; C, detail of posterior neuropodial acicular spines and capillaries. (Paratypes, Sta. 25, LACM-AHF Poly 6550).

Chaetozone camasetosa new species

Figures 17–18

Material examined. Southeastern Alaska, Boca de Quadra, Cruise 3BQ, R/V *Redoubt*, Sta. 100-2, 55°19.2'N, 130°29.2'W, 95 m, coll. Dec 1979, R.L. Cimberg, Van Veen grab, holotype (LACM-AHF Poly 6552), one paratype (LACM-AHF Poly 6553). **Prince Rupert, British Columbia**, off Ridley Island, coll. September 2012, AECOM by P. Winchell & S. Doner, few specimens mixed with *C. hobsonae* n. sp., mostly incomplete, 12–20 m (JAB).

Description. A moderate-sized species, holotype complete, 6.0 mm long, 0.4 mm wide for 65 setigerous segments; paratype in two pieces, 10.5 mm long, 0.5 mm wide for 64 setigerous segments; Prince Rupert specimens small, mostly incomplete. Color in alcohol light tan to brown, lacking any distinctive body pigment. Body generally thick, with narrow segments throughout, middle body segments widest; last 12–15 setigers formed into distinct cinctures with high membranes bearing spines. Dorsum rounded, with narrow and shallow dorsal groove apparent from about setiger 20, continuing along body until cinctured posterior segments; venter somewhat flattened, with well-developed ventral groove present from about setiger 20, continuing through middle body segments, not apparent posteriorly.

Prostomium swollen posteriorly, narrowing anteriorly to triangular, blunted margin (Fig. 17A); eyes absent; small slit-like nuchal organ present, not pigmented; peristomium with three nearly equal rings, merging with posterior margin of prostomium (Fig. 17A); achaetous segment absent; dorsal tentacles arising from posterior margin of posterior ring; first pair of branchiae lateral and slightly posterior to tentacles on anterior margin of setiger 1 (Fig. 17A); second pair of branchiae on posterior edge of setiger 1, dorsal to notosetae; subsequent setigers with branchiae in similar location.

Setiger 1 of approximately same size as last peristomial annulation and following segments; podial lobes reduced to inconspicuous ridges in anterior setigers; inflated and conspicuous in middle setigers, greatly enlarged with elevated ridges and conspicuous armature in posterior setigers (Fig. 17B); posterior segments separated by deeply cut intersegmental furrows (Fig. 17B).

Noto- and neurosetae from setiger 1 all capillaries; notosetae 9–10 per fascicle, neurosetae 6–8 per fascicle; each capillary thickened, with no distinct fibrils apparent along edge; middle body segments with long, natatory-like notosetae. Acicular spines first present from about setiger 30 in neuropodia and 40 in notopodia of holotype and

setiger 40 in neuropodia and 45 in notopodia of paratype; spines numbering 2–3 at first, accompanied by an equal number of thin capillaries; in far posterior setigers notopodial spines numbering 9–11 and neuropodial spines numbering 11–12, forming nearly complete cinctures with spines numbering 20–23 on a side and accompanied by alternating thin capillaries (Fig. 18A, B); spines with sharply pointed tip that curves back and adheres to shaft (Fig. 17C), with weak node or notch at point of emergence from podial lobe (Fig. 18C).

Last few cinctured setigers narrowing to posterior end; pygidium with terminal anus and small flattened ventral lobe (Fig. 17B).

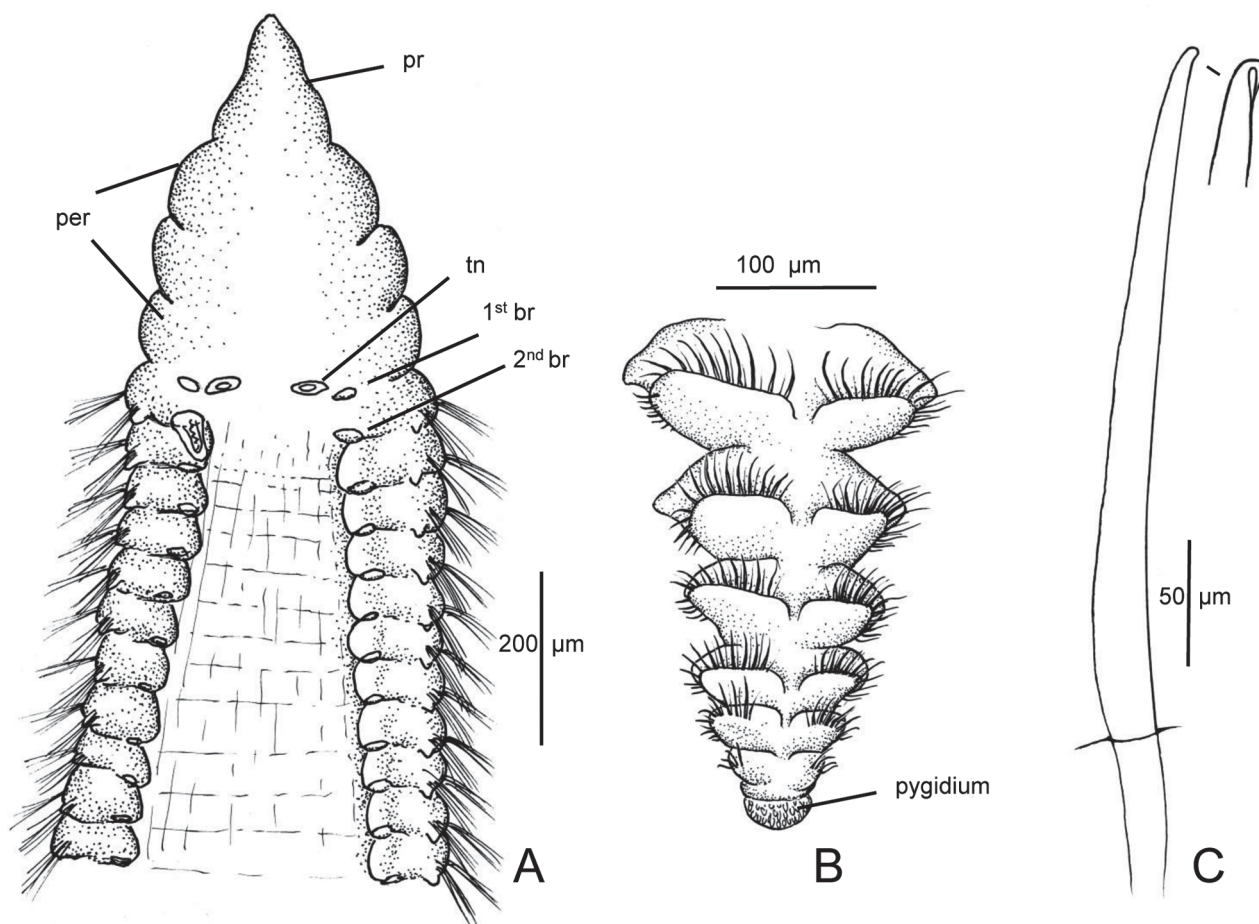


FIGURE 17. *Chaetozone camasetosa* n. sp. A, anterior end, dorsal view; B, posterior end, dorsal view; C, detail of far posterior acicular notopodial spine with recurved tip, inset not to scale. (A–B, holotype, LACM-AHF Poly 6552; paratype, LACM-AHF Poly 6553).

Methyl Green staining pattern. Tip of prostomium staining, last two peristomial rings staining, with some streaks extending dorsally onto expanded anterior peristomial ring.

Biology. Paratype with body full of oocytes about 70 µm in diameter.

Remarks. The curved tip of the posterior spines of *C. camasetosa* n. sp. occurs in a small group of *Chaetozone* species that includes *C. curvata* Hartmann-Schröder, 1965, from Chile, *C. commonalis* Blake, 1996 from California shelf depths, *C. allanotai* from California deep-water slope depths, and *C. anasima* Doner & Blake, 2006 from offshore New England. Of these, *C. curvata* and *C. commonalis* have the first pair of branchiae on setiger 1, whereas *C. allanotai*, *C. anasima*, and *C. camasetosa* n. sp. have an extra pair of branchiae lateral and posterior to the dorsal tentacles on the anterior margin of setiger 1, as well as a pair on the posterior margin of the same setiger. This condition suggests that a segment has been lost or fused with setiger 1. These three species differ from one another in that *C. anasima* lacks distinct peristomial rings including any demarcation or annulation between the peristomium and setiger 1; whereas, both *C. camasetosa* n. sp. and *C. allanotai* have two distinct rings. The latter two species appear to be closely related to one another and may be a shallow-water to deep-water sibling species pair. In *C. camasetosa* n. sp., the two peristomial rings are strongly set off from one another by deep annulations and also separated from the swollen posterior margin of the prostomium. In *C. allanotai*, the

peristomial rings are not strongly demarcated and, in addition, the first pair of branchiae actually occurs on setiger 1. Both species have different MG staining patterns on the prostomium and peristomium. *C. allanotai* appears to be limited to continental slope depths of 1800–3100 m and is a dominant species in the 2700–2850 m depth range from sites offshore northern California (Blake 2006). The specimens of *C. camasetosa* **n. sp.** examined here are from shelf depths of up to 95 m.

Etymology. The epithet is from the Latin *camur*, for crooked or curving inward, combined with *seta* referring to the manner in which the tip of the posterior spines curve inward merging on the concave side of the shaft and forming an apparent blunt tip.

Distribution. Southeastern Alaska to British Columbia, subtidal, 12–95 m. The specimens here suggest that they fragment easily and as such cannot be readily identified without the posterior modified spines.

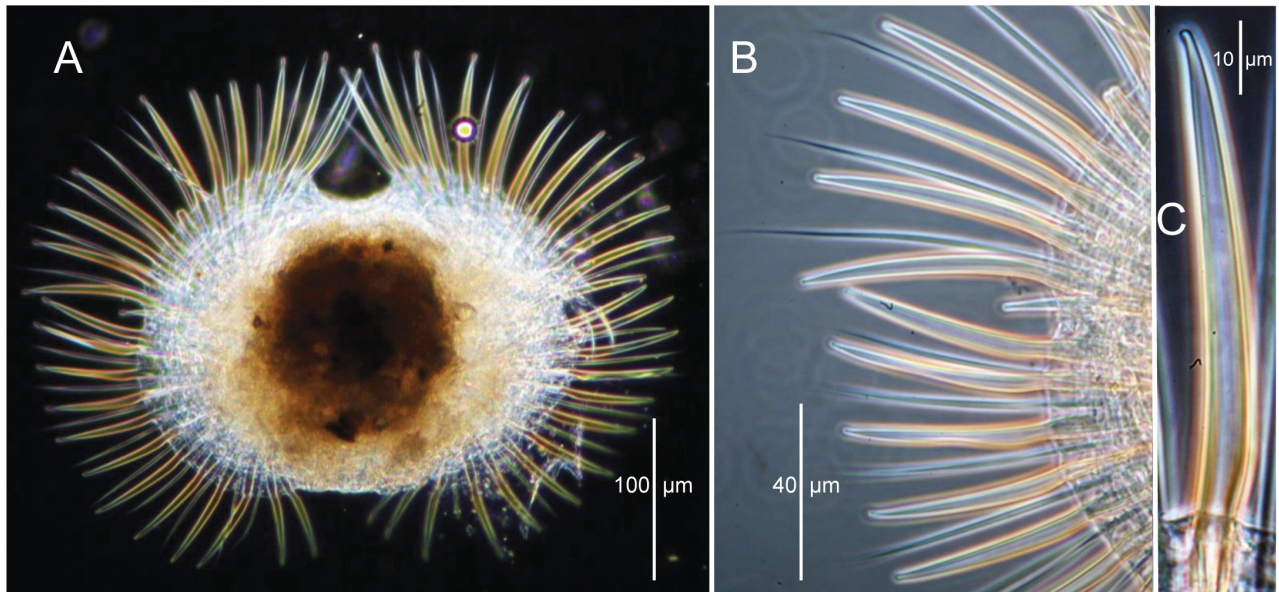


FIGURE 18. *Chaetozone camasetosa* **n. sp.** Photomicrographs: A, far posterior segment, anterior view; B, close up of far posterior noto- and neuropodial acicular spines and capillaries from same segment; C, detail of neuropodial acicular spine from same segment. (All paratypes, LACM-AHF Poly 6553).

Genus *Tharyx* Webster and Benedict, 1887

Type species: *Tharyx acutus* Webster & Benedict, 1887, by monotypy.

Diagnosis. Prostomium conical; peristomium elongate, with pair of grooved dorsal tentacles arising on posterior margin anterior to setiger 1; first pair of branchiae typically arising immediately posterior to dorsal tentacles either on posterior margin of peristomium or on setiger 1; abdominal segments sometimes beadlike. Noto- and neurosetae arising close to one another, not widely separated. Setae include simple capillaries in anterior and middle setigers, acicular spines in posterior setigers with irregular notched tips, sometimes appearing more or less bidentate, with pair of stunted or rounded knobs but never with distinct, sharply pointed teeth; spines present either in both posterior noto- and neuropodia or only in neuropodia. Pygidium with terminal anus and small ventral lobe or disk.

Remarks. Blake (1991) determined that the type species of *Tharyx*, *T. acutus* Webster & Benedict, 1887 had knob-tipped acicular spines in addition to capillaries. At the time, *Tharyx* species were defined as having only capillaries (Hartman 1961). Blake (1991) limited *Tharyx* to those species having knob-tipped spines and moved species having only simple or serrated capillaries to the genera *Aphelochaeta* Blake, 1991 and *Monticellina* Laubier, 1961 respectively. The genus *Tharyx* superficially appears most closely related to *Caulleriella* in that both genera have species with modified spines that are more or less bidentate. *Caulleriella* and *Tharyx* are easily distinguished, however, by the position of the noto- and neuropodia. In *Caulleriella*, the setal fascicles are widely separated from one another, so much so that in cross section of some species, they appear to be positioned at four corners. In *Tharyx*, on the other hand, the setal fascicles are close together.

Two new species of *Tharyx* are described as part of this study. One species from Alaska had been previously referred to the genus *Chaetozone*. The second species, from the Puget Sound, Washington, was known in Puget Sound monitoring programs under a provisional *Tharyx* designation.

***Tharyx alaskensis* new species**

Figures 19–20

Chaetozone setosa: Pettibone 1954: 287–288, Fig. 33d, in part. Not Malmgren 1867.

Chaetozone cf. *gracilis*: Busdosh 1984. Not Moore 1923.

Material examined. **Alaskan Arctic, Beaufort Sea, Prudhoe Bay**, coll. M. Busdosh, 06 Aug 1983, 70°24.1'N, 148°32.3.0'W, 2.5 m, push cores, Waterflood 6 project, R/V *Annika Marie*, Sta. 50-1, holotype (LACM-AHF Poly 6554), 10 paratypes (LACM AHF Poly 6555). **Off Point Barrow**, coll. G.E. McGinitie, 09 Aug 1949, 7 miles offshore, 128 m, stones and gravel, 1 specimen (USNM 1263247); coll. 06 September 1949, 7.5 miles offshore, 66 m, removed from growth on rocks, 2 specimens (USNM 1263248); 14 Oct 1949, 4 miles offshore, 53 m, gravel and small stones 1 specimen (USNM 22810).

Description. Holotype 11 mm long, 0.7 mm wide for ca. 75 setigerous segments; paratypes of similar size. Body light tan in alcohol, without pigment. Body with dorsum of anterior and middle segments slightly elevated above parapodia; venter somewhat flattened throughout body, with weak ventral groove in posterior 30 segments. First 12–15 segments narrower, more crowded than middle segments, no moniliform segments except in some juveniles; far posterior expanded region again with narrow, crowded segments (Fig. 20C).

Prostomium triangular, narrow, pointed on anterior margin; eyes absent (Figs. 19A, 20A); nuchal organs small, crescent shaped notch at posterior lateral margin of prostomium, not pigmented. Peristomium longer than wide, with 2–3 distinct annulations visible dorsally, depending on preservation (Fig. 20A), with 2–3 weak divisions ventrally; dorsal midline with a long ridge, extending to end of peristomium (Figs. 19A, 20A), better developed on some specimens. Paired dorsal tentacles arising from posterior margin of peristomium, first pair of branchiae arising lateral and posterior to tentacles on setiger 1 (Fig. 19A); second pair of branchiae on posterior margin of setiger 1, subsequent branchiae on following setigers.

Parapodia low mounds from which setal fascicles arise; noto- and neuropodial setal fascicles positioned close to one another throughout. Notoetae all capillaries for first 55 setigers with 5–7 capillaries in noto- and neuropodia; notoetae of far posterior setigers becoming spinous, straight, with blunt tips (Fig. 19D–E); natatory setae present in mature individuals; neuroetae transitioning from capillaries in anterior and middle setigers to short curved spines at about mid body, setiger 34 in holotype. Neuropodial spines curved, somewhat geniculate with tip blunt; shortest spines ventralmost (Fig. 19D, F).

Pygidium with dorsal anus and flattened ventral lobe (Figs. 19B–C, 20B).

Methyl Green staining pattern. No distinct staining pattern apparent.

Remarks. *Tharyx alaskensis* was one of the dominant polychaetes in surveys offshore Prudhoe Bay in shallow water as part of benthic monitoring associated with oil and gas development in the early 1980s (Busdosh 1984). At the time, the species was tentatively referred to *Chaetozone* cf. *gracilis* Moore, probably because posterior neuropodial spines appeared to be limited to the neuropodia. In actuality, there are spinous notoetae in far posterior notopodia, but they are stiff, narrow, thinner and with a blunt point instead of short, thick, and curved neuropodial spines. Based on Blake's (1991) revision of some cirratulid genera, these specimens should be referred to the genus *Tharyx* because the posterior spines are few, blunt-tipped, and not formed into cinctures. The species is unusual in that the posterior notopodial and neuropodial spines differ from one another: the notopodial spines are straight, stiff, thin, and elongate, whereas the neuropodial spines are curved, somewhat geniculate, short, and thick; both sets of spines are blunt-tipped and not pointed, but are not of the typical knob-tipped form of related species. A few specimens of *T. alaskensis* **n. sp.** were encountered among the cirratulids identified as *Chaetozone setosa* by Pettibone (1954) from off Point Barrow, Alaska, in deeper water and are described as *C. pigmentata* **n. sp.** elsewhere in this paper. Pettibone's Figure 33 D is most definitely *T. alaskensis* **n. sp.** because it clearly depicts two pairs of branchiae on setiger 1. The Point Barrow specimens agree very well with the shallower water specimens from Prudhoe Bay.

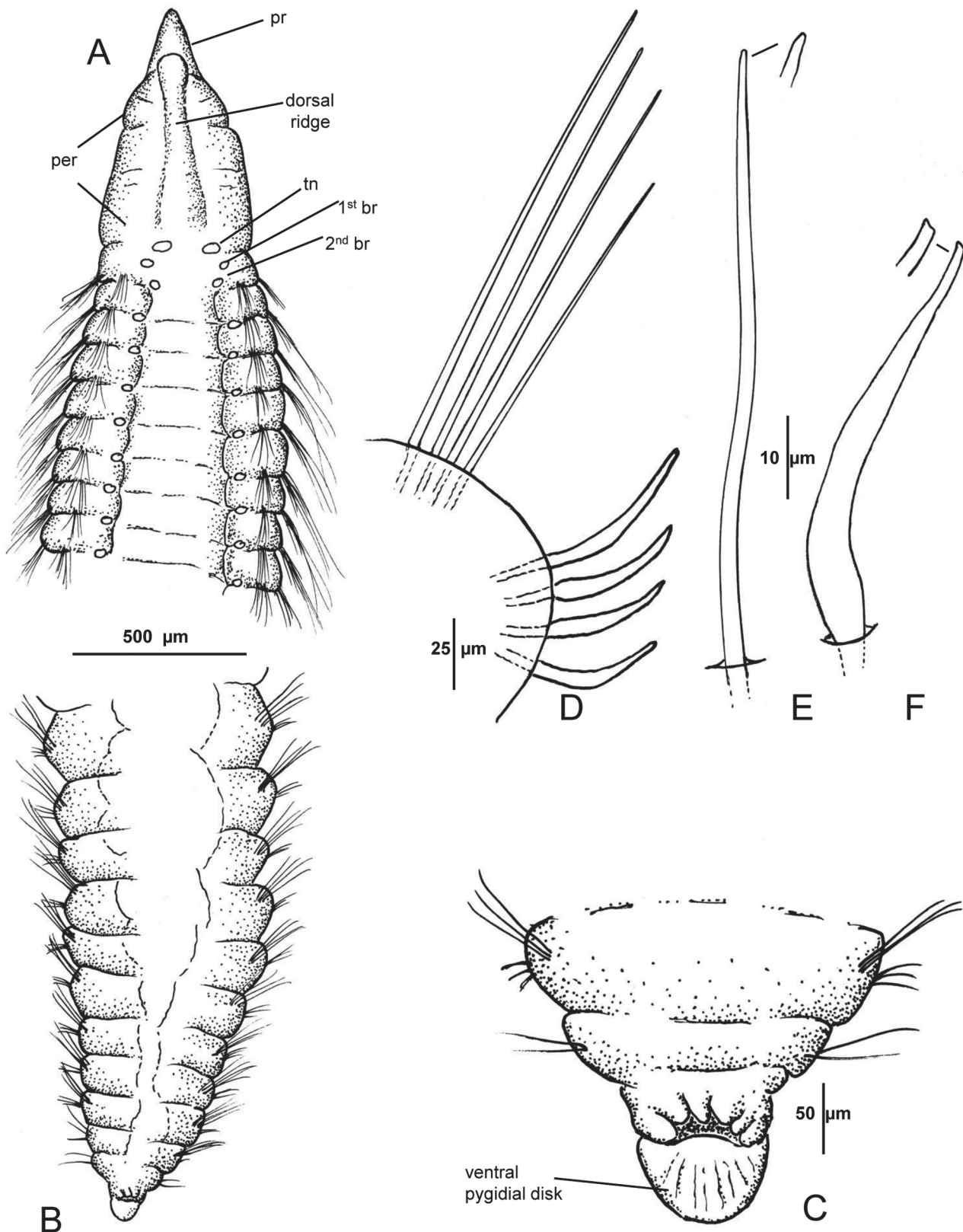


FIGURE 19. *Tharyx alaskensis* n. sp. A, anterior end, dorsal view; B, posterior end, dorsal view; C, pygidium, dorsal view; D, posterior parapodium; E, detail of posterior spinous notoseta, inset not to scale; F, detail of a neuropodial acicular spine in a posterior parapodium, inset not to scale. (All paratypes, LACM-AHF Poly 6555).

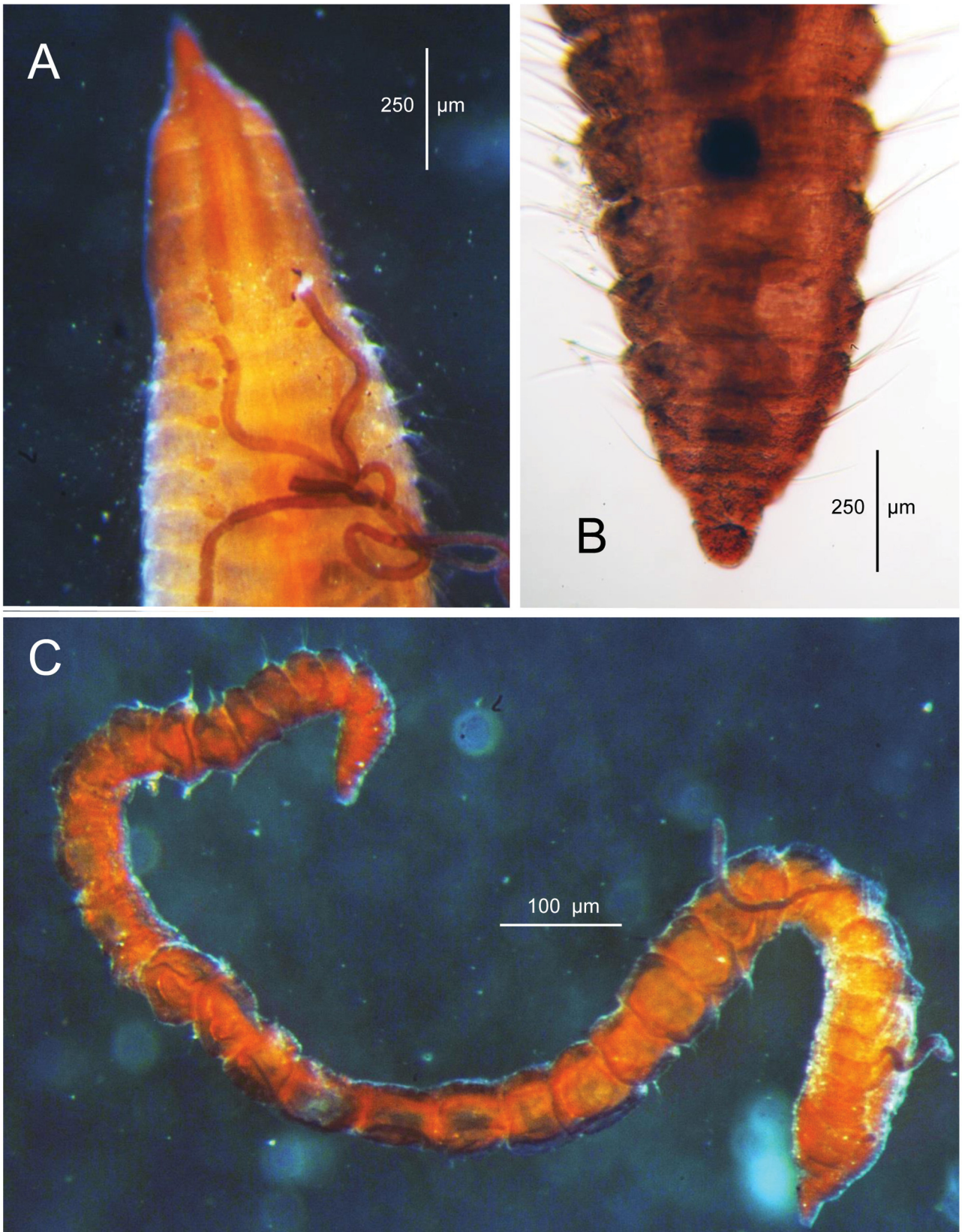


FIGURE 20. *Tharyx alaskensis* n. sp. A, anterior end, dorsal view; B, posterior end dorsal view; C, juvenile, entire animal, lateral view. (All paratypes, LACM-AHF Poly 6555; stained with Shirlastain A).

Tharyx alaskensis **n. sp.** appears most similar to *T. killariensis* (Southern, 1914), which was originally described from Ireland as a species of *Caulleriella* and is likely widespread in northern Europe (Blake & Göransson, in preparation). In *T. killariensis*, however, the posterior noto- and neuropodial spines are few in number and are accompanied by capillaries, which are not present in the far posterior parapodia of *T. alaskensis* **n. sp.** A major difference between *T. alaskensis* **n. sp.** and other species is that the first and second pairs of branchiae both occur on setiger 1. Other species either have the first pair of branchiae on the posterior margin of the peristomium or on an achaetous segment anterior to setiger 1 and the second pair on the subsequent setigerous segment.

Biology. *Tharyx alaskensis* **n. sp.** (as *Chaetozone* cf. *gracilis*) was the single most abundant benthic invertebrate collected during a monitoring survey in the Beaufort Sea, Prudhoe Bay, in August 1983 (Busdosh 1984). A total of 3,458 specimens were identified, accounting for 30.6% of the entire infaunal abundance. Other commonly associated species included the polychaetes *Eteone longa* (Fabricius, 1780), *Capitella capitata* (Fabricius, 1780), and *Chaetozone ruffi* **n. sp.** (as *C. setosa*), the cumacean *Diastylis sulcata* Calman, 1912, and the isopod *Saduria entomon* (Linnaeus, 1758). *Tharyx alaskensis* occurred in soft sediments, often with debris. One specimen with natatory setae was gravid, with the body filled with eggs of about 150 µm in diameter. The few specimens available from offshore Point Barrow in deeper water were largely collected from coarse rocky substrates.

Etymology. The name refers to Alaska, where the species occurs and appears to be endemic.

Distribution. Known only from Alaska, Beaufort Sea; shallow subtidal to 128 m offshore.

***Tharyx circacutus* new species**

Figures 21–22

Tharyx sp. N1: Provisional name, Washington State Department of Ecology's Marine Sediment Monitoring Program (MSMP); database (PSEMPMarineBenthicSpeciesList_sortable.xlsx) online: <http://www.eopugetsound.org/species/custom-lists/306>.

Material examined.—**Washington, Strait of Juan de Fuca**, east central Port Angeles Harbor, coll. WA Department of Ecology, Puget Sound Ecosystem Monitoring Program (PSEMP), Sta. 1121, 18 June 2013, 48° 07.9026' N, 123° 23.2853' W, 29.5 m depth, in sandy silt, holotype (LACM-AHF Poly 6556), 12 paratypes (LACM-AHF Poly 6557).

Description. Holotype 14.8 mm long, 0.43 mm wide for ca. 70 setigerous segments; largest paratype 16.4 mm long, 0.32 mm wide with 95 setigers. Body light tan in alcohol; with a cluster of lateral black pigment spots on posterior peristomium, otherwise without pigment except for a few cells surrounding nuchal organs on some specimens. Body long, slender, with first 15–20 segments expanded, widest part of body with narrow, crowded segments each four times wider than long; following segments becoming as long as wide, with some in middle of body almost moniliform; far posterior segments narrowing to small pygidial segment. Body mostly cylindrical in cross section, with weakly developed ventral groove in far posterior segments.

Prostomium triangular, tapering to pointed anterior margin; eyes absent (Figs. 21A–B, 22A–B); nuchal organs narrow slits surrounded by pigmented cells (Fig. 21B). Peristomium wider than long, with one annulation visible laterally and dorsally (Figs. 21A–B, 22A); dorsal midline with a low, weakly developed ridge extending to end of peristomium (Figs. 21A, 22A). Paired dorsal tentacles arising from posterior margin of peristomium; first pair of branchiae arising lateral and posterior to tentacles on posterior edge of peristomium (Figs. 21A, 22A); second pair of branchiae arising from posterior margin of setiger 1, dorsal to notosetae.

Parapodia low ridges from which setal fascicles arise; noto- and neuropodial setal fascicles positioned close to one another throughout. Notosetae all capillaries throughout (Fig. 21D–E); 5–7 in anterior setigers, reduced to 4–5 in far posterior parapodia. Neurosetae all capillaries in anterior setigers, with ventral-most setae transitioning to shorter, recurved spines in middle body (setiger 38 in holotype and setiger 40 in largest paratype); spines curved, somewhat geniculate with blunt tip; shortest spines in ventral position (Fig. 21F–H); spines accompanied by 2–4 dorsal capillaries at first (Fig. 21D), far posterior setigers with 3–5 spines and no capillaries (Fig. 21E).

Pygidium with dorsal anus and small ventral lobe (Figs. 21C, 22C–D).

Methyl Green staining pattern. Stain retained in intersegmental grooves of some anterior and middle body segments; weak mid-ventral stain sometimes evident.

Remarks. The nature of the prostomium and peristomium of *Tharyx circacutus* n. sp. are typical for most species of *Tharyx* where branchiae begin posterior to the tentacles at the posterior margin of the peristomium and the second pair of branchiae begin on setiger 1. Curved posterior spines are limited to the neuropodia and begin about three-fourths of the way along the body; in far posterior segments the spines assume the blunt, knob-tipped appearance of other *Tharyx* spp.

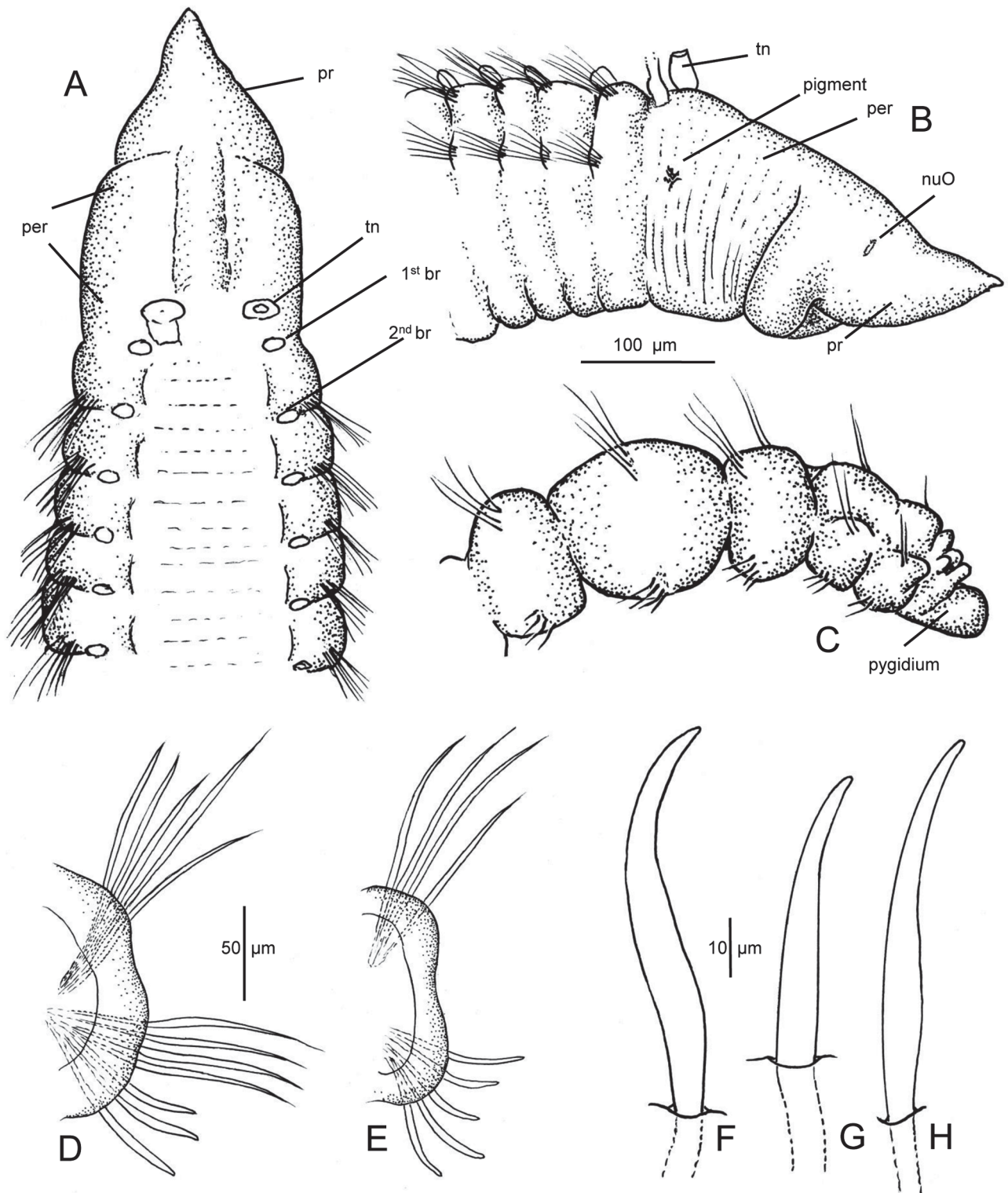


FIGURE 21. *Tharyx circacutus* n. sp. A, anterior end, dorsal view; B, anterior end, lateral view; C, posterior end, lateral view; D–E, posterior parapodia, anterior views; F–H, neuropodial acicular spines in posterior parapodia. (A–B, holotype, LACM-AHF Poly 6556; C–H, paratype LACM-AHF Poly 6557).

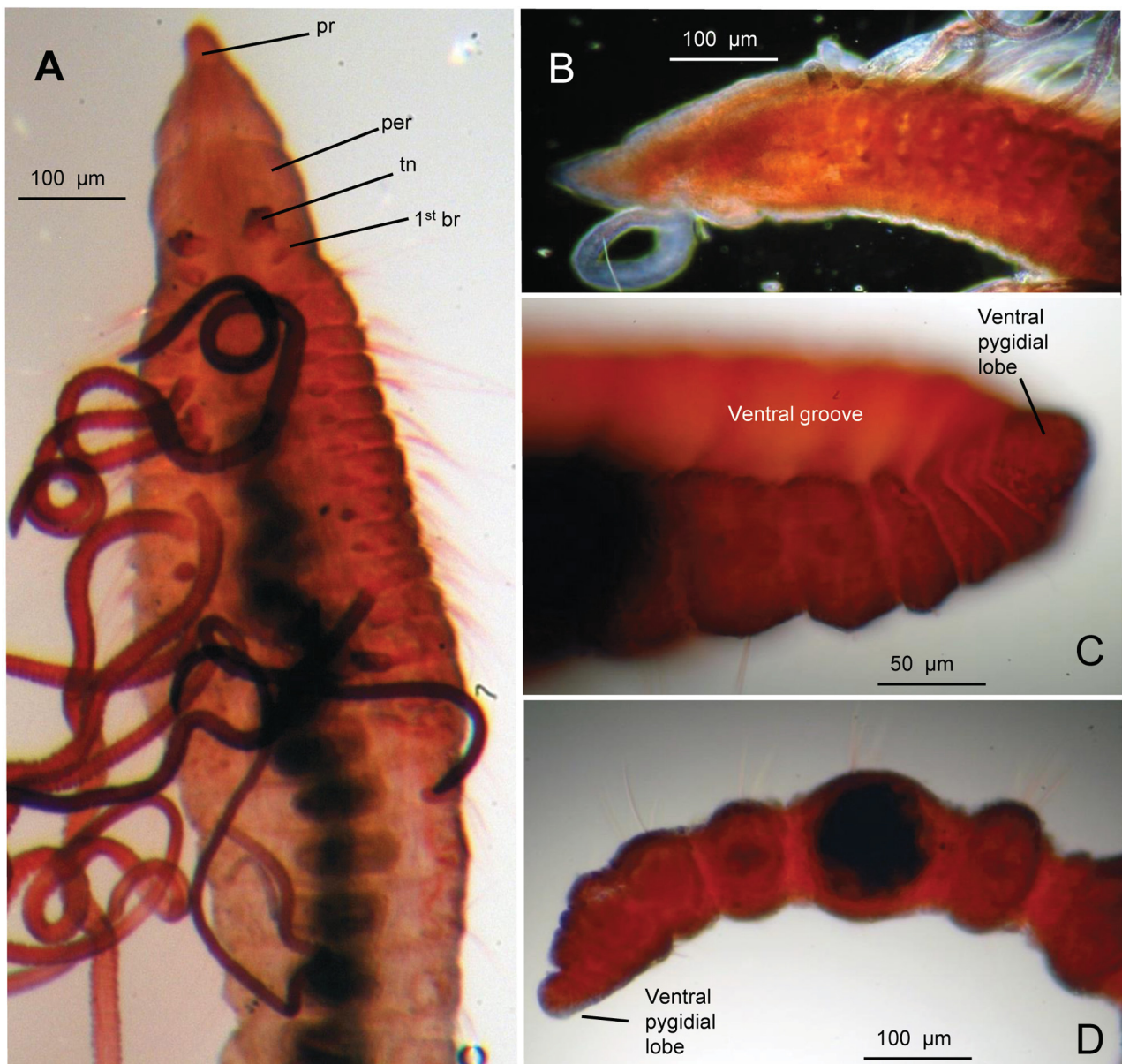


FIGURE 22. *Tharyx circacutus* n. sp. Photomicrographs: A, anterior end, dorsal view; B, anterior end, left lateral view; C, posterior end, ventro-lateral view; D, posterior end, right lateral view. (A, holotype, LACM-AHF Poly 6556; B–D, paratype, A LACM-AHF Poly 6557; all stained with Shirlastain A).

T. circacutus n. sp. most closely resembles the type species, *T. acutus*, from the northeastern United States in having the posterior spines limited to the neuropodia (Blake 1991). However, the pigmented nuchal organs, the very narrow almost moniliform posterior end, and the very narrow, slender body differ noticeably from *T. acutus*, which lacks pigmented nuchal organs and in which the entire body and posterior end are more robust with none of the segments appearing moniliform. Further, the body of *T. circacutus* n. sp. is nearly round in cross section whereas the body of *T. acutus* is thicker and somewhat dorsoventrally flattened.

Etymology. The Latin *circa* for around or near is combined with the Latin term *acutus* for sharp pointed and the species name of the type-species *Tharyx acutus*, with which this new species is closely related.

Distribution. Known from shallow subtidal habitats in the Puget Sound.

Discussion

Genus *Chaetozone*. The most extensive recent review of the Cirratulidae from American waters was by Blake (1996) who reviewed 46 species, 20 of which were new to science, from the Eastern North Pacific. Of these, 13 species of *Chaetozone*, seven new to science were described and illustrated. As part of this monograph, type specimens and additional collections of *Chaetozone* and other cirratulids reported from the State of Washington and British Columbia reported by Berkeley & Berkeley (1952) and Banse & Hobson (1968) were reviewed and redescribed. Three additional new deep-water species of *Chaetozone* were subsequently described from off San Francisco by Blake (2006), bringing the total number of known *Chaetozone* species from the North American Eastern Pacific to 16; additional deep-water species are recognized but not yet described (Blake unpublished). Blake (1996) alluded to Arctic collections of *Chaetozone*, but did not elaborate on them except for comments relating to the type species, *C. setosa*. The eight new species described in the present paper bring the number of *Chaetozone* species known from the NE Pacific and Arctic and subarctic waters of North America to 23; the specimens of *C. setosa* reported in Blake (1996) are described as *C. malmgreni* n. sp. in the present paper. All of the NE Pacific and North American Arctic species of *Chaetozone* are compared in Table 2.

Farther south, three new species and range extensions for two known species were reported and described by Dean & Blake (2007) from the Pacific coast of Costa Rica. Three additional new species of *Chaetozone* were described by Doner & Blake (2006) from the NE United States and additional species are known from the Atlantic and Gulf coasts of North America; the genus *Chaetozone* is thus one of the largest and most diverse groups of cirratulids from North America. Globally, the number of recognized new species is increasing as well. New species from Europe and off the Faroes have been described by Woodham & Chambers (1994), Chambers (2000), and Chambers & Woodham (2003) and others are known (Chambers *et al.* 2007; Doner, unpublished). Magalhães & Bailey-Brock (2013) described two new species of *Chaetozone* from the Hawaiian Islands and a rich cirratulid fauna from South America and Antarctica includes several new species of *Chaetozone* (Blake, manuscript in preparation).

Two earlier records of *Chaetozone* from the Gulf of St. Lawrence, eastern Canada, named by McIntosh (1911) have gone largely unnoticed: *Chaetozone setosa* var. *canadensis* McIntosh, 1911 and *C. whiteavesi* McIntosh, 1911. The only character of note for *C. setosa canadensis* is that the spines were reported to have a distinct curve at the end of the shaft and that the blade was very flat. No species of *Chaetozone* having this character has been encountered in samples from eastern side of Canada as part of this study. According to correspondence between the late Dr. Mary E. Petersen and the Natural History Museum, London, the type specimens of *C. setosa canadensis* cannot be found. McIntosh (1911) indicated that *C. whiteavesi* had only capillary setae throughout; this was confirmed after examining the syntypes (ZK 1921.5.1.3241/44) in the Natural History Museum, London. This species therefore is referred to the genus *Aphelochaeta*.

Taxonomic characters important for identification of Chaetozone species. Traditionally, the main characters used to identify species of *Chaetozone* have included (1) body shape, (2) number of peristomial rings or annulations and their size and shape, (3) presence or absence of eyes, (4) setiger where the first noto- and neuropodial spines begin, (5) the structure of these spines, (6) nature of the modified posterior segments and whether “cinctures” are developed, and (7) nature of the pygidium.

These characters are still important, but with the discovery of more species and diversity (Blake 1996; Blake 2006; Doner & Blake 2006; Dean & Blake 2007; this paper), additional characters are being defined: (1) development of an achaetous segment between the peristomium and first setiger, (2) position of the paired tentacles and first pair of branchiae, (3) presence and development of dorsal and ventral grooves and ridges along the body, (4) further details on the development of the modified posterior cinctures, (5) presence or absence of long, natatory-like notosetae, (6) body pigment, and (7) presence or absence of a MG staining pattern. New observations on some of these characters are discussed below.

Body shape. Body shape in *Chaetozone* species has been found to be useful in certain instances to easily identify some species. In general, species of *Chaetozone* have thickened bodies with thoracic segments crowded and narrow, with the body tapering posteriorly where the segments become longer and less crowded; far posterior segments include the characteristic cinctures and spinous armature. *C. gibber* Woodham & Chambers, 1994 from the U.K. and coast of France has been found to have a thick body but also an especially enlarged thoracic region that is dorsally elevated and with a “hump-backed” shape. *C. brunnea* Blake from deep-water off California has a relatively narrow thoracic

region of narrow crowded segments, but at the transition to the abdominal segments an enlarged internal stomach precedes moniliform abdominal segments. A similar appearing species with an enlarged stomach, *C. ronaldi* Magalhães & Bailey-Brock (2013), has been described from Hawaii and another species is known from Antarctic waters (Blake unpublished). While these examples provide easily recognizable superficial characters, other more typical appearing species are often variable in shape and with little consistency in their overall appearance.

Peristomial rings and annulations. The number, size, shape, and arrangement of peristomial rings or annulations provide important characters to assist in species identification. However, the actual grooves that separate one annulation from another or from the achaetous segment may be difficult to interpret because they are often only visible laterally or otherwise are incomplete. Complete rings such as occur in *C. malmgreni* **n. sp.** are generally rare. Dorsal ridges or crests on the peristomium may extend over all rings limiting them to only lateral visibility as in *C. pugettensis* **n. sp.**, and *C. setosa*. In some instances, it is only with the use of Shirlastain A that the grooves are enhanced sufficiently to be observed with light microscopy. SEM is the best tool, if available.

Nature of the pygidium and lobes. Typically, the pygidium of species of *Chaetozone* consists of a simple terminal segment with an anal opening above a ventral lobe or plate-like disk. Rarely, there is a terminal cirrus on the disk as in *C. columbiana*. In most cases the pygidium is not a character used to define a species.

Presence or absence of eyes. Eyes have been reported for several species of *Chaetozone* (Blake 1996; Woodham & Chambers 1994; Chambers 2000) and are sometimes used to distinguish individual species or groups of species (Chambers *et al.* 2007). However, pigmented cells often surround the nuchal organs and may be mistaken for eyes due to their position and pigmentation. Published reports of prostomial eyes in *Chaetozone* species do not typically include evidence of photoreceptors actually being present. In burrowing polychaetes, simple prostomial photoreceptors or eyes vary from simple pigmented cups or ocelli to more complex structures with a distinct lens surrounded by pigmented cells (Eakin & Hermans 1988). For this reason, the identification of eyes in species of *Chaetozone* needs to be confirmed by thin sections, preferably by electron microscopy. Comparison with the larger and more conspicuous eyes of species of *Cirratulus* would also be instructive. Among species in the eastern Pacific, eyes have been identified for *Chaetozone acuta* Banse & Hobson, 1968 and *C. corona* Berkeley & Berkeley, 1941 (Blake 1996). In *C. acuta* the eyes are cup-shaped, reddish, and clearly seen anterior to the nuchal organs; in *C. corona* they are black and appear to be composed of several fused elements (Blake 1996). In the present study, *C. pugettensis* **n. sp.** may have pigmented nuchal organs or these may be absent. A more distinct eye-like structure observed in *C. hobsonae* **n. sp.** is clearly a nuchal slit surrounded by pigmented cells. The presence or absence of pigmented cells surrounding the nuchal organs may be used as a taxonomic character; however, the presence or absence of true eyes needs to be confirmed by detailed observations.

Segment where the first noto- and neuropodial spines begin. In nearly all species, the neuropodial spines appear before the notopodial spines. In *C. corona*, the neuropodial spines appear on setiger 1; in *C. pigmentata* **n. sp.**, they begin on anterior setigers 5–25 depending on the size of the specimens; in most other species the neuropodial spines begin in middle body segments; in a few species they begin in posterior segments. In my opinion the value of this character is limited because one needs to understand the size range of the species being examined and inherent variability that depends on the age/size of the specimen. When sufficient material is available to define where these spines begin, it may be preferred to categorize species into groups depending on whether they first occur in anterior, middle, or posterior segments.

Presence of an achaetous segment between the peristomium and setiger 1 and position of the tentacles, and first pair of branchiae. Most species of *Chaetozone* examined have a distinct achaetous segment between the peristomium and setiger 1. In some instances, as in *C. palaea* Blake, 2006 and *C. careyi* **n. sp.**, the achaetous segment is indistinguishable in appearance from the first setiger except that setae are absent. In other cases the posterior-most annulation of the peristomium is interpreted as an achaetous segment if it is narrow and bears a pair of branchiae. In *C. malmgreni* **n. sp.** from offshore Oregon (this study) and *C. ronaldi* from Hawaii (Magalhães & Bailey-Brock 2013) both the dorsal tentacles and first pair of branchiae occur on the achaetous segment. In other species such as *C. anasima*, *C. hystricosa*, *C. hobsonae* **n. sp.**, and *C. ruffi* **n. sp.**, superficial evidence of an achaetous segment is not readily apparent even after staining with Shirlastain A and/or examination with SEM; therefore, the position of the first pair of branchiae is interpreted as peristomial. In *C. camasetosa* **n. sp.**, both the first and second pair of branchiae occur on setiger 1, suggesting that an achaetous segment has been lost and merged into setiger 1; the only remaining evidence of the missing segment is the location of the first pair of branchiae on the anterior margin of the setiger instead of the posterior margin where all subsequent branchiae occur. *C. michellae* from Hawaii is clearly illustrated

with both the first and second pairs of branchiae on setiger 1, but this is not mentioned in the text (Magalhães & Bailey-Brock 2013).

The wide range of modifications to the peristomium and the anterior segments observed in species of *Chaetozone* will require the use of histological techniques in order to fully understand the segmentation of the peristomium and the nature and origin of achaetous segments that occur anterior to the setigerous segments. For practical purposes, the position of the dorsal tentacles is typically associated with the posterior margin of the peristomium or they sometimes arise from a groove or notch at that location. Rarely do they occur on or over a defined segment except where the posterior margin of the peristomium is shifted posteriorly and extends over some anterior body segments as in *C. bansei* and *C. careyi* **n. sp.** In those species, the first pair of branchiae typically occurs on an achaetous segment lateral and posterior to the origin of the tentacles.

Dorsal and ventral grooves and ridges along the body. Details concerning dorsal and ventral grooves or ridges along the body of *Chaetozone* and other cirratulid genera is rarely mentioned in published descriptions. Some species have deep grooves either dorsally or ventrally that extend either along the entire body or only part; other species have narrow or shallow grooves. Several species listed in Table 1 have a shallow groove on some or all of the body. Magalhães & Bailey-Brock (2013) reported a deep dorsal groove present along the body in *C. michellae* from Hawaii. Less frequently observed are distinct ridges along the ventral midline. In *C. pigmentata* **n. sp.**, a ventral line of bulges associated with each segment forms a distinctive feature in this species. A similar but less developed ridgeline is present in *C. bathyala* **n. sp.** Similar structures have been seen in some species of *Aphelochaeta* but none are reported as such in the literature (Blake unpublished). It is likely that these will be found to be more common upon further investigation. In the case of *C. pigmentata* **n. sp.**, this feature serves as a species-specific character.

Modification of the posterior parapodia or development of cinctures. Most *Chaetozone* species have the posterior segments modified with the successive segments becoming narrow and pinched off from one another forming what are called cinctures. These cinctured segments might be thought to resemble an accordion where the groove between the segments expands or contracts with movement. Each cinctured segment bears fascicles of heavy spines and accompanying capillaries that are arranged into a distinct armature in which the spines emerge from elevated, membranous podia and protrude outward. In some cases the noto- and neurosetae overlap laterally; sometimes the notosetae overlap at the dorsal midline and the neurosetae overlap at the ventral midline. In these extreme cases, the distinction between noto- and neurosetae is not obvious superficially. The degree to which these posterior cinctured and spinous segments develop is variable and may be used to help distinguish one *Chaetozone* species from another. In *C. pigmentata* **n. sp.** from Arctic North America, the posterior segments bear spines and capillaries, and each segment is distinct from one another, but deep cinctures between these segments do not develop; nor do the spines of individual noto- and neuropodia, which typically number no more than 11–12 on a side, overlap in any orientation; a similar situation is reported by Chambers (2000) for *C. christei* Chambers, 2000. In contrast, *C. palaea* from deep-water off California represents an extreme development of the posterior armature in which the spines are unusually broad, are not accompanied by capillaries, and number up to 22 on a side; the spines of the noto- and neuropodia completely overlap in all orientations.

Acicular spines. The acicular spines themselves differ in size and form. Spines are typically weakly curved, thick or thin and/or broad and terminate in either a blunt or pointed tip. The group of species represented by *Chaetozone camasetosa* **n. sp.** and *C. anasima* has a narrow spine that terminates in a fine tip that curves back onto the shaft where it adheres, superficially forming a blunted tip. Most species have spines with internal fibrils evident as longitudinal striae. Solitary bidentate spines have been sometimes reported in the ventral-most position in neuropodial fascicles and the dorsal-most position in notopodial fascicles that contain unidentate spines; for example, in *C. lunula* and *C. diodonta* Doner & Blake, 2006. *C. hartmanae* Blake, 1996 has heavy curved posterior neuropodial spines with a crest of small teeth on the convex surface of the tip, whereas the notopodial spines are straight and smooth along the entire shaft. *Chaetozone flagellifera* Gallardo, 1967 from Viet Nam has acicular spines limited to the neuropodia; these spines bear a long apical arista (Gallardo 1967), similar to those of some Paraonidae and it is likely that this species belongs to another genus.

Awl-shaped setae. Chambers (2000) reported awl-shaped capillaries in her redescription of *Chaetozone setosa* and description of *C. christei*. The nature of these capillaries is not clear; her illustrations only indicate narrow, tapering capillaries, no different from those found on most polychaetes. The term awl-shaped is defined in most dictionaries as a structure thickened at the base and tapering to a point or needle-shaped (Blake 1994). This definition suggests that awl-shaped setae might be transitional between capillaries and acicular spines. In any case, such setae were not observed in any of the species observed as part of this project including *C. setosa*.

Natatory-like notosetae. Long natatory-like notosetae were present in most, but not all, species examined as part of the present study. When present, these are long, thin, flexible setae that arise from discrete parts of the body or along most of it. Chambers (2000), as part of her redescription of *C. setosa*, noted that all specimens bore these long notosetae and that they occurred from about setiger 21 and continued for another 30 or more setigers. These observations are confirmed in the redescription of *C. setosa* within the present paper. In contrast, *C. christei*, described in the same paper by Chambers (2000), lacked these long capillaries. In the present study, the long natatory-like capillaries were in some instances associated only with specimens that were sexually mature. For species where the long notosetae were not observed, there may have been insufficient material or they were simply absent in all life stages. Because of the definite relationship of these long capillaries with sexual maturity in some species, their presence or absence cannot be used as a consistent taxonomic character.

Pigmentation. Distinct body pigmentation on species of *Chaetozone* is rare. However, three species have recently been encountered having body pigment: *C. brunnea* from off California, *C. pigmentata* **n. sp.**, and *C. bathyala* **n. sp.**, both from the North American Arctic. *C. brunnea* and *C. pigmentata* **n. sp.** have groups of individual cells that are typically pigmented brown in preservative. *C. bathyala* **n. sp.** has patches of dark pigment that are more like chromatophores. When present, natural body pigment is an important taxonomic character. In life, the pigment of *C. brunnea* is actually blue-green (Blake, personal observations).

Methyl Green staining pattern. The Cirratulidae is one of the polychaete families where MG staining patterns have proven useful to separate one species from another (Blake 1996; 2006; Doner & Blake 2006, 2009; Magalhães & Bailey-Brock 2013; this paper). In species of *Chaetozone* where staining patterns are present, there are usually areas of the prostomium and peristomium that are both stained and unstained, thus imparting specific patterns. The body segments may also retain stain either over the entire segmental surface, limited to dorsal or ventral areas, in intersegmental grooves, or by staining groups of cells in limited areas.

Important characters necessary to characterize the various species of *Chaetozone* reported by Blake (1996, 2006, this paper) are presented in Table 2.

Identification of distinct species groups. Elucidation of the additional characters described here allows for distinct groups of *Chaetozone* species to be defined within the genus for the first time providing a practical approach to categorizing species with similar characters. Examples include:

The *Chaetozone setosa* group: Species with an enlarged lobe or crest overlying the peristomium: *C. setosa*, *C. carpenteri*, *C. corona*, *C. platycera*, and *C. pugettensis* **n. sp.**

The *Chaetozone bansei* group: Species with the dorsal tentacles shifted posteriorly, overlying a setigerous segment: *C. bansei*, *C. careyi* **n. sp.**, and *C. lunula*.

The *Chaetozone curvata* group: Species with the acicular spines having a fine tip, that curves back and fuses with the shaft forming a superficial blunt tip: *C. allanotai*, *C. anasima*, *C. camasetosa* **n. sp.**, *C. commonalis*, and *C. curvata*.

Species with body pigmentation:

C. bathyala **n. sp.**, *C. brunnea*, and *C. pigmentata* **n. sp.**

Species groups can also be defined by the presence/absence of an achaetous segment between the peristomium and setiger 1 and in combination of the origin of the dorsal tentacles and first pair of branchiae. For example, at least four species have no apparent achaetous segment yet have two pairs of branchiae on setiger 1, suggesting that a segment has been lost or merged with setiger 1 (*C. camasetosa* **n. sp.**, *C. michellae*, *C. senticosa* Blake, 1996 and *C. spinosa* Moore, 1903).

Genus *Tharyx*. Blake (1991) originally included five species in *Tharyx*, none of which were from the NE Pacific or Arctic. Blake (1996) later determined that *Tharyx parvus* E. Berkeley, 1929, referred by Blake (1991) to *Aphelochaeta*, was in fact a true *Tharyx* and redescribed it based on the holotype from British Columbia and new materials from California. *T. kirkegaardii* Blake, 1991, a deep-water species from the western North Atlantic, was also discovered off California by Blake (1996). Magalhães & Bailey-Brock (2013) described one new species from Hawaii. Two new species, *T. alaskensis* **n. sp.** from the Arctic and *T. circacutus* **n. sp.** from Puget Sound, are described in this paper, bringing the total number of described species to nine. Several additional species of the genus are known from the U.S. Atlantic and Gulf coasts, northern Europe, Antarctica, and deep-water off northern California but to date are not described. However, unlike *Chaetozone*, *Tharyx* is a relatively small genus with known and yet-to-be-described species probably not exceeding 15–20 species. However, when present, some species of *Tharyx* have proven to very abundant and are often a dominant taxon in benthic samples (Hilbig & Blake 2000). This

is the case for *T. alaskensis* **n. sp.** in shallow sediments offshore Prudhoe Bay, where the species (as *Chaetozone* cf. *gracilis*) represented over 30% of the entire benthic fauna collected (Busdosh 1984).

Taxonomic characters important for identification of Tharyx species. Important characters for identification of *Tharyx* species include: (1) body shape, (2) location of the dorsal tentacles and first pair of branchiae, (3) presence/absence of lateral peristomial pigment spots, (4) presence/absence of posterior notopodial acicular spines, and (5) nature of the of the posterior acicular spines.

Body shape. All species of *Tharyx* described to date have long, slender bodies beginning with a narrow elongated head region (prostomium + peristomium) and continuing through anterior, middle, and posterior segments. The anterior segments tend to be somewhat shorter and wider than middle and posterior segments, but a larger inflated thoracic region is generally lacking. Middle body segments may sometimes be as long as wide, and in some species, middle and posterior segments may be moniliform. The far posterior segments may be as long as wide or become narrow with crowded segments, but a distinct expanded posterior end as occurs in many species of *Aphelochaeta* does not develop.

Location of the dorsal tentacles and first pair of branchiae. The dorsal tentacles are located on the posterior part of the peristomium, immediately followed by the first pair of branchiae, typically also on the peristomium, or as in *T. alaskensis* **n. sp.**, on the anterior margin of setiger 1, resulting two branchiae on the same setigerous segment.

Presence/absence of lateral peristomial pigment spots. Some species have groups of black pigment spots placed laterally on the peristomium as in *T. kirkegaardi* and *T. circacutus* **n. sp.** This pigment when present provides an immediate clue as to the identity of the species.

Presence/absence of posterior notopodial acicular spines. All species of *Tharyx* have neuropodial spines, but some like *T. acutus* the type species and *T. circacutus* **n. sp.** lack notopodial spines. When present, they may be of the same structure as the neuropodial spines as in *T. kirkegaardi* or of an entirely different kind as in *T. alaskensis* **n. sp.**

Nature of the posterior acicular spines. The acicular spines of *Tharyx* species are typically geniculate in shape in the neuropodia and variably shaped in the notopodia. Notopodial spines when present are usually less geniculate or curved, and narrower such as in *T. alaskensis* **n. sp.** Tips of the acicular spines are typically blunt, flattened, or with an irregular shape that is knobby or sub-bidentate but not distinctly bidentate as in species of *Caulleriella*. The shaft immediately below the tip may be finely serrated as in *T. kirkegaardi*. Capillaries do not alternate with spines in posterior segments as in species of *Chaetozone*. Instead, the superior setae in a fascicle may become longer, less acicular and grade into thickened setae with capillary tips.

Key to 21 species of *Chaetozone* from the Northeastern Pacific and North American Arctic and Subarctic

(Reference code: 1, Blake 1996; 2, Blake 2006; 3, this paper. Note: *Chaetozone gracilis* Moore, 1923 and *C. armata* Hartman, 1963, both redescribed in Blake [1996] are rare species not included in this key; both lack posterior cinctures and may belong to other genera. MG = Methyl Green).

- 1A. Paired dorsal tentacles on posterior margin of peristomium shifted posteriorly over anterior setigerous segments 2
- 1B. Paired dorsal tentacles on posterior margin of peristomium or anterior achaetous segment, not shifted posteriorly over setigerous segments 4
- 2B. Dorsal tentacles shifted dorsally over setiger 1 3
- 2B. Dorsal tentacles shifted dorsally over setigers 4–7; with distinct MG staining pattern *C. bansei*¹
- 3A. With distinct achaetous segment preceding setiger 1, bearing first pair of branchiae; all spines in posterior cinctures unidentate; no MG staining pattern *C. careyi* **n. sp.**³
- 3B. Without distinct achaetous segment preceding setiger 1, first pair of branchiae on setiger 1; ventral-most spine in posterior neuropodia of cinctures bidentate; with distinct MG staining pattern *C. lunula*¹
- 4A. Posterior noto- and neuropodial spines with sharply pointed with recurved tip extending posteriorly and fused with shaft forming blunt tip 5
- 4B. Posterior noto- and neuropodial spines sharply pointed or blunt, not with recurved tip 7
- 5A. First pair of branchiae on setiger 1; no MG pattern *C. commonalis*¹
- 5B. First and second pair of branchiae both on setiger 1 6
- 6A. Posterior spines from posterior third of body, or about setiger 65 in neuropodia and setiger 70 in neuropodia; dorsal longitudinal groove absent; with thin ridge along ventral midline; posterior cinctures well developed, with 26–29 spines on a side, over-

- lapping at dorsal midline of each cincture; MG staining prostomium and peristomium, but with clear unstained curved dorsal band between at posterior margin of prostomium. *C. allanotai*²
- 6B. Posterior spines from middle body segments, or setigers 30–40 in neuropodia and 40–45 in notopodia; shallow dorsal groove from anterior through middle segments, absent posterior segments; ventral groove in middle segments; posterior cinctures well developed, with 20–23 spines on a side; MG on tip of prostomium and last two peristomial rings *C. camasetosa* n. sp.³
- 7A. With distinct achaetous segment between peristomium and setiger 1, may be partially fused to setiger 1 8
- 7B. Without distinct achaetous segment between peristomium and setiger 1 15
- 8A. Achaetous segment bearing both first pair of branchiae and dorsal tentacles. 9
- 8B. Achaetous segment bearing only first pair of branchiae; dorsal tentacles arising from peristomium or notch at posterior margin 10
- 9A. Body with distinct enlargement (stomach) between esophagus of thoracic segments and intestine of abdominal segments, this imparting characteristic shape to body; with brown pigment over most of body, concentrated in anterior segments; posterior cinctures well developed, with 16–18 spines on a side; no MG pattern evident *C. brunnea*²
- 9B. Body without distinct morphological enlargement except for segments sometimes swollen with gametes; pigment absent; posterior cinctures well developed, with 15–17 spines on a side; MG pattern on prostomium, peristomium, and anterior parapodia; peristomium with two prominent annulations anterior to achaetous segment separated by deep grooves, first annulation inflated, twice size of second *C. malmgreni* n. sp.³
- 10A. Neuropodial spines from setiger 50–70 or greater in middle body segments, in middle body segments; spines arranged in partial or complete cinctures; MG staining pattern present or absent 11
- 10B. Neuropodial spines from setiger 5–40 in anterior third of body; spines arranged in partial or complete cinctures; MG staining pattern present or absent 12
- 11A. Neuropodial spines from setiger 70 or greater; posterior cinctures partial, with up to 14 spines on a side; peristomium not overlain with dorsal crest; MG stains prostomium and peristomium intensely, except for tip of prostomium and dorsal surface of peristomial annulations; parapodia with weak stripes across dorsum and venter. *C. hedgpethi*¹
- 11B. Neuropodial spines from setiger 50–53; cinctures with 17–19 spines on a side; peristomium overlain with prominent crest; no MG pattern *C. pugettensis*, n. sp.³
- 12A. Posterior cinctures with 20–22 unusually long, broad, flattened, pointed noto- and neuropodial spines on a side, without accompanying capillaries; with MG pattern *C. palaea*²
- 12B. Posterior cinctures with thick, rounded noto- and neuropodial spines, pointed or blunt-tipped, with accompanying and alternating capillaries 13
- 13A. Some anterior capillaries sometimes with splayed fibrils; other capillaries from setiger 40–45 short, an oblique edge with fibrils, tapering to pointed tip; with posterior cinctures greatly reduced to only 8 spines on a side, each with thin fringe along convex side; neuropodial spines from setiger 18–40; no MG pattern. *C. acuta*¹
- 13B. Fibrils not conspicuous on capillaries; posterior cinctures reduced or complete, but with 13 or more spines on a side 14
- 14A. Body heavily pigmented with numerous brown to black pigment speckles over entire body; with a prominent mid-ventral ridge line along entire length of body formed of ventromedial bulges arising from each segment; with weak mid-dorsal groove in middle body segments; neuropodial spines from setigers 5–26; posterior cinctures reduced, with 13–19 spines on a side; no MG pattern *C. pigmentata* n.sp.³
- 14B. Body with anterior segments with diffuse black pigment, not discrete speckles, limited to certain areas of the body, not all over; ventral ridge low, not conspicuous; posterior cinctures well developed, with elevated membranes with 20–22 spines on a side; with distinct MG staining pattern, with all of prostomium except tip staining, with most of peristomium staining forming “mask” over the head region. *C. bathyala* n.sp.³
- 15A. Neuropodial spines from setiger 1 *C. corona*¹
- 15B. Neuropodial spines from setiger 20 or later 16
- 16A. Neuropodial spines from setiger 21–40 17
- 16B. Neuropodial spines from setiger 65 or later 19
- 17A. Posterior notopodial spines typically longer, narrower and pointed than heavier, blunt-tipped neuropodial spines, forming partial cinctures 18
- 17B. Posterior notopodial and neuropodial spines both similar, curved with smooth shafts and pointed tips; fully developed cinctures with 17–19 spines on a side; with MG *C. hobsonae* n.sp.³
- 18A. Posterior spines in partial cinctures, 8–10 spines on a side; with 4–5 long, narrow, straight, blunt-tipped notopodial spines and 4–5 short, thick, curved, neuropodial spines having short serrations on convex side of curved tip; with MG staining. *C. hartmanae*¹
- 18B. Posterior spines in partial cinctures, 16–18 spines on a side; posterior notosetae spinous with sharp tips; posterior neurosetae becoming shorter, forming blunt-tipped spines; no MG staining pattern *C. spinosa*^{1,2}
- 19A. Neuropodial spines from mid-body segments, setigers 58–65; MG staining present or absent. 20
- 19B. Neuropodial spines from posterior third of body, setigers 105–120; posterior cinctures partially developed, with 11–12 spines on a side; MG stains with distinctive pattern *C. columbiana*¹
- 20A. Neuropodial spines from setiger 65–80; posterior cinctures weakly developed, with 8–9 spines on a side; with weak MG reaction. *C. senticosa*¹
- 20B. Neuropodial spines from setiger 58–65; posterior cinctures fully developed with up to 22 spines on a side; without MG staining pattern *C. ruffi* n. sp.³

TABLE 2. Taxonomic Characteristics of 21 Species of *Chaetozone* from the NE Pacific and The North American Arctic Compared with the Type-Species *Chaetozone setosa* from Spitsbergen in the Norwegian Arctic.

| Species | Nature of Segment | Position of first Pair of Branchiae | Position of the Paired Tentacles | Nature of Posterior Cinctures | Nature of Posterior Spines | Companion Setae with Spines | Podial Development of the Cinctures |
|--|---|---|---|---|--|---|-------------------------------------|
| <i>Chaetozone setosa</i> Malmgren, 1867 | Achaetous, incomplete partially fused to setiger 1 | On achaetous segment 1 | In notch between posterior peristomium and segment 1 | Complete, with 10–12 spines in notopodia and 10–12 spines in neuropodia; 20–24 spines on a side | Broad, curved, pointed on tip, with internal striae | Long thin capillaries | High, thin membrane |
| <i>Chaetozone acuta</i> Banse & Hobson, 1968 | Achaetous, incomplete, partially fused to setiger 1 | On achaetous segment 1 | Posterior margin of peristomium | Partial, with 2–5 spines in notopodia and 5–7 spines in neuropodia; 7–12 spines on a side | Spines curved, with blunt tips and thin fringe or sheath on convex side | Long thin capillaries | Low, inconspicuous membranes |
| <i>Chaetozone bansei</i> Blake, 1996 | Same as setiger 1 | On last peristomial annulation | Shifted posteriorly over setigers 4–7 by extension of prostomium over peristomium | Partial, with 5–6 spines in noto- and neuropodia; 10–12 spines on a side | Spines curved, with blunt tips; notoaciculars generally longer than neuroaciculars | Long thin capillaries | Low, inconspicuous membranes |
| <i>Chaetozone columbiana</i> Blake, 1996 | Same as setiger 1 | At posterior margin of peristomium | At posterior margin of peristomium | Partial, with 5–6 spines in noto- and neuropodia; 11–12 spines on a side | Spines, curved, tapering to bluntly pointed tips | Long, thin capillaries | Low, inconspicuous membranes |
| <i>Chaetozone corona</i> Berkeley & Berkeley, 1941 | Same as setiger 1 | On last peristomial annulation, lateral to dorsal tentacles | On last peristomial ring | Partial, with 5–6 spines in noto- and neuropodia; 10–12 spines on a side | Spines weakly curved, tapering to narrow tip; notoaciculars longer, thinner than neuroaciculars | Long, thin capillaries | Moderately developed membranes |
| <i>Chaetozone commonalis</i> Blake, 1996 | Same as setiger 1 | On setiger 1 | On last peristomial ring | Complete with 11–12 spines in neuropodia and 10–12 spines in notopodia; 22–24 spines on a side | Spines with sharply pointed tip, curving back and merging with shaft forming blunted tip | Long thin capillaries | With moderately developed membranes |
| <i>Chaetozone hartmanae</i> Blake, 1996 | Same as setiger 1 | On setiger 1 | Posterior margin of peristomium | Partial with 4–5 spines in neuropodia and 3–4 in notopodia; 7–9 spines on a side | Notoaciculars narrow, straight, pointed on tip; neuroaciculars heavy, curved, with concave side serrated | Thin capillaries becoming thicker, spinous along body | Podia reduced |
| <i>Chaetozone hedgpethi</i> Blake, 1996 | Achaetous, partially fused to setiger 1 | On achaetous segment 1 | On peristomial annulation anterior to segment 1 | Complete with 7 spines in notopodia and 8 spines in neuropodia or 15 spines on a side | Spines geniculate, curving to pointed tip | Long, thin capillaries | With low membranes |

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| Species | Long, Natatory-like Notosetae | Approximate Segmental Origin of spines | Dorsal Longitudinal Grooves or Ridges | Ventral Longitudinal Grooves or Ridges | Pygidium | Methyl Green Stain (MG) | Distribution |
|--|-------------------------------|--|--|---|---|---|---|
| <i>Chaetozone setosa</i> Malmgren, 1867 | Present in all specimens | Posterior one-third; ~51 notopodia; ~58 notopodia; with up to 93 setigers | Weakly developed, limited to anterior segments | With deep mid-ventral groove along body | Small ventral lobe | MG stains peristomium and with ventral bands on anterior and far posterior segments | Spitsbergen; Arctic and subarctic; (Petersen 1999; Chambers 2000; this paper) |
| <i>Chaetozone acuta</i> Banse & Hobson, 1968 | Not observed | Anterior one-third; 18–40 notopodia; 55–60 notopodia; with 92–155 setigers | Absent or weakly developed | Not observed | Ventral lobe | No distinct MG pattern | NE United States, Puget Sound, 15–35 m |
| <i>Chaetozone bansei</i> Blake, 1996 | Not observed | Anterior one-third; 28–29 notopodia; ~80 in notopodia; with ca. 150 setigers | Absent | Not observed | Ventral cup-like lobe | MG distinct; peristomium and peristomium staining intense, separated by clear band; MG encircling anterior segments | California to Oregon, shallow shelf depths |
| <i>Chaetozone columbiana</i> Blake, 1996 | Not observed | Posterior one-third; 105–120 notopodia; 120–135 notopodia; with ca. 170 setigers | Absent | Prominent ventral groove along body; less developed posteriorly | Terminal anus, with short blunt lobe bearing cirrus | MG staining peristomium and peristomium intensely; anterior 2.5 or more segments with light bands | Oregon and Washington, subtidal, sandy sediments |
| <i>Chaetozone corona</i> Berkeley & Berkeley, 1941 | Not observed | Anteriormost setigers; Setiger 1 in notopodia; 8–9 in notopodia | Absent | Shallow ventral channel | Terminal anus with blunt, ventrally directed lobe | Prostomium, peristomium, and edges of setiger 1 staining intensely; tip of prostomium not staining | Western Mexico to Central California off Santa Barbara, 24–119 m |
| <i>Chaetozone commonalis</i> Blake, 1996 | Not observed | Posterior one-third; 38–40 in notopodia; 43–47 in notopodia; for ~60 setigers | Absent | Shallow groove along entire length of body | Terminal anus, with ventral flattened, saucer-like lobe | No apparent MG staining reaction | Central California in shelf depths |
| <i>Chaetozone hartmanae</i> Blake, 1996 | Not observed | Anterior one-third; ~33 in neuro-podia; ~40 in notopodia; for 100–110 setigers | Dorsum elevated posteriorly | With distinct ventral groove in posterior segments | With a ventrally directed triangular lobe | MG staining body uniformly with no pattern; each parapodium with band of speckles on anterior edge | Southern California in shelf and slope depths |

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TABLE 2. (Continued)

| Species | Nature of Segment 1 | Position of first Pair of Branchiae | Position of the Paired Tentacles | Nature of Posterior Cinctures | Nature of Posterior Spines | Companion Setae with Spines | Podial Development of the Cinctures |
|---|-----------------------------------|---|--|---|---|--------------------------------------|--|
| <i>Chaetozone lumula</i> Blake, 1996 | Same as setiger 1 | On last peristomial annulation | On last peristomial annulation | Complete with 5–6 spines in notopodia and 6 or 11–12 spines on a side | Spines sigmoid with thickened borders, curving to pointed tip; ventral most neuropodial spine bidentate | Long thin capillaries | With well-developed membranes and deep cinctures |
| <i>Chaetozone senticosa</i> Blake, 1996 | Fused with segment 2 (=setiger 1) | On fused setiger 1 with 2 nd pair of branchiae | On last peristomial annulation | Partial, with 5 spines in notopodia and 4–5 in neuropodia or up to 10 spines on a side | Spines sigmoid with thickened borders, curving to pointed tip | Long thin capillaries | Weakly developed cinctures, without elevated membranes |
| <i>Chaetozone spinosa</i> Moore, 1903 | Fused with segment 2 (=setiger 1) | Lateral to dorsal tentacles on fused segments 1–2 followed by second pair of branchiae | In groove at posterior margin of peristomium | Partial, with 8–9 spines in noto- and neuropodia; 16–18 spines on a side | Short, curved, blunt tipped | Long thin capillaries | Low, inconspicuous membrane |
| <i>Chaetozone palaea</i> Blake, 2006 | Achaetous, complete | On achaetous segment 1 | Posterior margin of peristomium | Complete, with 9–10 spines in notopodia and 11–12 spines in neuropodia; 20–22 spines on a side | Very broad, sharply pointed with internal chamber | Absent or rare | High, inflated membrane |
| <i>Chaetozone brunnea</i> Blake, 2006 | Achaetous, reduced | Posterior to dorsal tentacles; on achaetous segment 1 | On segment 1 | Complete, with 7–8 spines in notopodia and 9–10 spines in neuropodia; 16–18 spines on a side | Broad, curved, blunt-tipped, with internal striae | Thick, spinous appearing capillaries | Moderate, thin membrane |
| <i>Chaetozone allanotai</i> Blake, 2006 | Fused with segment 2 (=setiger 1) | Immediately posterior to dorsal tentacles; on fused segments 1–2 followed by second pair of branchiae | Posterior margin of peristomium | Complete, with 11–13 spines in notopodia and 15–16 spines in neuropodia; 26–29 spines on a side | Spines with sharply pointed tip, curving back and merging with shaft forming blunted tip | Narrow, pointed spinous capillaries | High, thin membrane |
| <i>Chaetozone pigmentata</i> , n. sp. | Achaetous complete | Posterior to tentacles on segment 1 | In groove at posterior margin of peristomium | Weakly developed, with 6–9 spines in notopodia; 7–10 in neuropodia; 13–19 spines on a side | Notoaciculars long, narrow pointed; neuroaciculars short curved, pointed | Alternating thin capillaries | Absent |

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Continued.

| Species | Long, Natatory-like Notosetae | Approximate Segmental Origin of spines | Dorsal Longitudinal Grooves or Ridges | Ventral Longitudinal Grooves or Ridges | Pygidium | Methyl Green Stain (MG) | Distribution |
|---|------------------------------------|---|--|---|---|--|---|
| <i>Chaetozone hedgpethi</i> Blake, 1996 | Not observed | Mid-body; 70–115 in neuropodia; 100–145 in notopodia; 170–200 total segments | With weak groove in middle segments | Ventral groove present along body | Terminal anus with small ventral lobe | MG staining peristomium and weak stripes across dorsum of parapodia | Northern California in embayments; intertidal to shallow subtidal |
| <i>Chaetozone lunula</i> Blake, 1996 | Present, middle body segments | Anterior one-third; 35–40 neuropodia; 43–45 in notopodia; up to 290 total segments | Absent | Ventral groove present | Terminal anus, ventral lobe bearing terminal cirrus | MG with anterior and middle body segments with some stain on posterior margin | Central California in shelf depths, 77–190 m. |
| <i>Chaetozone senticosa</i> Blake, 1996 | Not observed | Mid-body; 65–80 in neuropodia; 80–115 in notopodia; with 160–190 setigers | Mid-dorsal furrow or depression present | Venter flattened, groove absent | With triangular, blunt lobe | No apparent MG staining pattern | Central and Northern California in shallow embayments |
| <i>Chaetozone spinosa</i> Moore, 1903 | Present or absent | Anterior one-third; 21–33 neuropodia; ~45 notopodia; for ~85 setigers | Shallow dorsal groove along most of body | With segmental ridges along ventral midline | Cupped ventral lobe | No MG apart from band encircling tip of prostomium | California continental slope; shelf off Japan (Blake 1996; 2006) |
| <i>Chaetozone palaea</i> Blake, 2006 | Present | Anterior one-third; ~21 neuropodia; with ca. 60 setigers | Mid-body to posterior end | Weak mid-ventral ridge present | Ventral lobe and two dorsal lobes | MG staining peristomium, part of peristomium, & first 2–3 segments | California continental slope (Blake 2006) |
| <i>Chaetozone brunnea</i> Blake, 2006 | Present or absent | Posterior one-third; ~30 neuropodia; ~35 notopodia; with 45–55 setigers | Absent | Absent | Simple ventral disc | No MG pattern | California continental slope (Blake 2006) |
| <i>Chaetozone allanotai</i> Blake, 2006 | Present or absent | Posterior one-third; ~65 neuropodia; ~70 notopodia; with ~90 setigers | Absent | Thin ventral ridge along ventral midline | Simple ventral disc | MG staining peristomium and peristomium, with clear, unstained dorsal band at posterior margin of prostomium | California continental slope (Blake 2006) |
| <i>Chaetozone pigmentata</i> , n. sp. | Present, sexually mature specimens | Anterior one-third; 5–25 neuropodia; 30–50 setigers in notopodia; with up to 100 setigers | Very weak dorsal groove | Prominent ventral ridge along body | Simple ventral lobe | No MG pattern | Canadian and Alaskan Arctic from Pt. Barrow to Baffin Island and Labrador |

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TABLE 2. (Continued)

| Species | Nature of Segment 1 | Position of first Pair of Branchiae | Position of the Paired Tentacles | Nature of Posterior Cinctures | Nature of Posterior Spines | Companion Setae with Spines | Podial Development of the Cinctures |
|---------------------------------------|---------------------|---|---|---|--|--|-------------------------------------|
| <i>Chaetozone bathyda</i> , n. sp. | Achaetous complete | Segment 1 | Last peristomial ring | Complete, with high membranes, 8–10 spines in notopodia; 10–12 spines in neuropodia; 20–22 spines on a side | Noto- and neuroaciculars similar, thick, bluntly pointed | Capillaries in upper part of notopodia and lower part of neuropodial fascicles | High, thin membrane |
| <i>Chaetozone careyi</i> , n. sp. | Achaetous complete | Segment 1 | Over segment 1 (setiger 1) | Moderately developed, 5–7 spines in notopodia; 7–10 spines in neuropodia; 12–17 spines on a side | Thickened basally, curving and tapering to blunt tip | Alternating, long, thin capillaries | Moderately developed membranes |
| <i>Chaetozone ruffi</i> , n. sp. | Same as setiger 1 | Posterior margin of last peristomial annulation | Dorsal surface of last peristomial annulation | Complete, 10–11 spines in noto and neuropodia with up to 22 spines on a side | Thickened basally, curving to blunt tip | Alternating, long, thin capillaries | High thin membranes |
| <i>Chaetozone malmgreni</i> , n. sp. | Achaetous complete | Segment 1 | Segment 1 with first pair of branchiae | Complete, 7–8 spines in notopodia, 8–9 spines in neuropodia; 15–17 spines on a side | Narrow, slightly curved, pointed | Alternating, thin capillaries | Moderately high membranes |
| <i>Chaetozone pugetensis</i> , n. sp. | Achaetous complete | Segment 1 | In groove at posterior margin of peristomium, anterior to segment 1 | Complete with 8–9 spines in notopodia and 9–10 in notopodia; 17–19 spines on a side | Thickened, blunt-tipped, slightly curved | Thin capillaries | High, thin membranes |
| <i>Chaetozone hobsonae</i> , n. sp. | Same as setiger 1 | Posterior margin of last peristomial annulation | In groove at posterior of last peristomial annulation | Complete, with 7–8 spines in notopodia and 10–11 in neuropodia; 17–19 spines on a side | Spines pointed, slightly curved | Long, thin capillaries | High, thin membranes |
| <i>Chaetozone camasetosa</i> , n. sp. | Same as setiger 1 | Anterior margin of setiger 1; 2 nd pair of branchiae on same setiger | Posterior margin of last peristomial annulation | Complete, with 9–11 spines in notopodia and 11–12 spines in neuropodia; 20–23 spines on a side | Spines with sharply pointed tip, curving back and merging with shaft forming blunted tip | Thin capillaries | High thin membranes |

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Continued.

| Species | Long, Natatory-like Notoetae | Approximate Segmental Origin of spines | Dorsal Longitudinal Grooves or Ridges | Ventral Longitudinal Grooves or Ridges | Pygidium | Methyl Green Stain (MG) | Distribution |
|--|--|--|--|---|--|---|---|
| <i>Chaetozone bathyala</i> , n. sp. | Present, sexually mature specimens | Anterior one-third; 18–25 neuropodia; 30–50 setigers in notopodia; up to 80 setigers | No dorsal groove | Weak ventral ridge along ventral midline | Short, protruding dorsal lobe | MG distinct: prostomium except tip staining; most of peristomium staining; grooves separating peristomial rings either staining poorly or not | Canadian Arctic and sub-Arctic; deep-water from 390–1745 m. |
| <i>Chaetozone careyi</i> , n. sp. | Present or absent; when present limited to middle body | Mid-body; 60–65 neuropodia; 90 + notopodia; up to 120 setigers | Weak dorsal groove | Distinct ventral groove | Elongate ventral lobe | No MG pattern | Alaskan Arctic to Canadian Subarctic in shallow depths |
| <i>Chaetozone ruffi</i> , n. sp. | Not observed | Posterior one-third; 58–65 neuropodia; 56–57 notopodia; with up to 100 setigers | Moderately developed, best developed posteriorly | Deep ventral groove along entire ventral surface | Small rounded, ventral lobe | No MG pattern | Alaskan Arctic, shallow subtidal |
| <i>Chaetozone malmgreni</i> , n. sp. | Not observed | Anterior one-third; 20–35 neuropodia; 40–45 notopodia; over 100 setigers | Shallow, narrow dorsal groove along entire body | Deep ventral groove along entire ventral surface | With small, flattened ventral lobe | With distinct MG pattern on prostomium, peristomium, and anterior parapodia | Offshore NE Pacific in shelf depths |
| <i>Chaetozone pugettensis</i> , n. sp. | Not observed | Posterior one-third; 50–53 neuropodia; ~60 notopodia; with 85–90 setigers | Absent or weakly developed | Deep, prominent mid-ventral groove | With small flattened ventral plate or disk | No MG pattern | Puget Sound, shallow waters |
| <i>Chaetozone hobsonae</i> , n. sp. | Present from ca. setigers 15–20 to posterior end in 50% of specimens | Mid-body; 35–40 in neuropodia; from setiger 50 in notopodia; with 80–85 setigers | Weakly developed mid-dorsal groove in anterior one-third of body | Narrow ventral groove; absent from cinctured segments | Terminal anus and small flattened ventral disk | MG on last peristomial ring and setiger 1; some segmental stain on setigers 2–3; some anterior setigers staining ventrally | SE Alaska to British Columbia, 12–95 m. |
| <i>Chaetozone camasetosa</i> , n. sp. | Present in middle body segments | Mid-body; 30–40 in neuropodia; 40–45 in notopodia; with 60–65 setigers | Shallow dorsal groove from ca. setiger 20 posteriorly; absent far posterior segments | Ventral groove present mid-body segments | Terminal anus and flattened ventral lobe | MG on tip of prostomium, last two peristomial rings | SE Alaska to British Columbia, 12–95 m. |

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